Issues Concerning the Adoption and Usage of Electronic Medical Records in Ministry of Health Hospitals in Saudi Arabia

By

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Abstract

Background: There is a lack of research with regard to understanding the factors that motivate hospitals to proceed with implementing Electronic Medical Record Systems (EMR). The Health Information Management and System Society (HIMSS) outlines eight levels of EMR implementation from 0 (no implementation) to 7 (full use and implementation of the system). Some hospitals proceed to implement EMR and achieve a high level of implementation, while others stop at a certain level of EMR implementation or may even regress to lower levels.

Aims and Methods: This research aimed to develop a framework to understand the motivational and de-motivational factors for proceeding with EMR implementation to uncover which hospitals have implemented EMR, to which levels, and how hospitals perceive EMR. In order to accomplish this, a mixed method design was adopted including a survey and case studies of a sample of hospitals in Eastern Saudi Arabia. The three case study sites were: a large hospital located in the capital city, a medium hospital located in a town, and a small hospital located in an isolated rural area.

Results: The study found that 3 out of 29 hospitals in the area had implemented EMR. Contrary to expectations, the largest hospital located in the central city had regressed from level four of EMR implementation to level one, whereas the smallest hospital located in an isolated rural location achieved the highest EMR level. It was found that there were common factors that affected all the case study sites, while other factors varied among them. Shared factors motivating sites to adopt EMR included a desire to escape from the manual system, whereas shared de-motivational factors included funding and technical problems. As these factors were common across sites at different levels of implementation, it is suggested that they do not sufficiently explain the variance in implementation level. It is argued that factors which varied between sites, however, may shed more light on the main motivators for implementation. For example, although there were technical problems across the sites, the way these technical problems were treated made the difference in terms of the success of the implementation. Additionally, top management commitment, users'

involvement in the EMR development and other factors varying between sites appeared to make the difference in the implementation's success.

Conclusion: The study concluded that all these common and varied factors affected staff attitudes toward the system. However, the site-related factors were perceived to be the main driver for the variance in the implementations. Since all site-related factors are controllable by top management, it is recommended that EMR implementation should be managed and supervised by a committee consisting of representatives from among clinical staff and IT staff. Based on this research, it is believed that such a committee is necessary for proceeding with an EMR implementation. However, there is no empirical evidence from this research about that. Therefore, it is advised that future research should find the rules, authorities and compositions of such committees that would make the committee effective.

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DEDICATION

To my dear mother

Salma to whom I am indebted for the rest of my life

To the soul of my

honorable father **Mohammad Al Aswad**

To my loyal husband

Atif Al Aswad for his support and encouragement

To my lovely sons **Mohammad**, **Mohannad**, and **Mazen**

To my sweet daughters **Noor** and **Shahad**

To all those I love

Amal Al Aswad

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II- Abbreviations

Abbreviation	Long name
AHIMA	American Health Information Management Association
ANA	American Nursing Association
ANOVA	Analyses Of Variance
ALBs	Arm's-Length Bodies
Amb	Ambulance
BBC	British Broadcasting Corporation
BCM	Business Change Management
CBAHI	Central Board for Accreditation of Healthcare Institutions
CDR	Clinical Data Repository
CDS	Clinical Decision Support
CDSS	Clinical Decision Support System
CEOs	Chief Executive Officers
CPR	Computer-based Patient Record
CPHIMS	Certified Professional Health Information Management System
CPOE	Computerized Physician Order Entry
CSC	Computer Sciences Corporation
CSF	Critical Success Factors
CT scan	Computerized Tomography Scan
Dep	Department
DoH	Department of Health
eHealth	Electronic Health
EHR	Electronic Health Records
EHS	Electronic Health System
EPR	Electronic Patient Records
EMAR	Electronic Medication Administration Record application
eMAR	Electronic medication administration record
EMRAM	Electronic Medical Record Adoption Model
EMR	Electronic Medical Record
ENT	Ear, Nose, Throat
ER	Emergency Room
ERP	Enterprise Resources Planning
EU	Europe
FGD	Focus Group Discussion
FMW	Female Medical Ward
FSW	Female Surgical Ward
GA	General Anastasia
GPs	General Practitioners
Gyn	Gynaecology

HE	Health Exchange
HIMSS	Healthcare Information and Management Systems Society
HIE	Health Information Exchange
HIS	Health Information System
HL7	Health Level Seven
HR	Human Recourse
HSPH	Harvard School of Public Health
HITECH	Health Information Technology for Economic and Clinical Health
ICD	International Classification Diseases
ICU	Intensive Care Unit
ID	Identification Data
IT	Information Technology
IOM	Institute of Medicine
IS	Information Systems
JCI	Joint Commission International
KSA	Kingdom of Saudi Arabia
KSAU-HS	King Saud Bin Abdul Aziz University for Health Sciences
LIS	Laboratory Information System
Max	Maximum
Min	Minimum
MMW	Male Medical Ward
MoH	Ministry of Health
MPI	Master Patient Index
MRI	Magnetic Resonance Imaging
MSW	Male Surgical Ward
NAHIT	National Alliance for Health Information Technology
NCD	Nursing Clinical Documentation
NPfIT	National Programme for Information Technology
NARA	National Archives and Records Administration
NAO	National Audit Office
NIH	National Institute of Health
NHS	National Health Services
OGC	Office of Government Commerce
OPD	Out Patient Department
Obs	Obstetrics
PACS	Picture Archiving Communications Systems
PBMRs	Paper-Based Medical Records
PCEHR	Personally Controlled Electronic Health Record
PCIS	Patient Care Information System
P-CMMSM	People Capability Maturity Model SM
PEOU	Perceived Ease of Use

ID	Identification Data
POMR	Problem Oriented Medical Record
PU	Perceived Usefulness
PW	Pediatric Ward
RADT	Registration, Admission, Discharge and Transfer
R-PACS	Radiology- Picture Archiving Communications Systems
RIS	Radiology Information Systems
RFID	Radio Frequency Identification
ROI	Return On Investment
SAHI	Saudi Association for Health Informatics
ScHARR	School of Health and Related Research
SEIfPS	System Engineering Initiative for Patient Safety
SLA	Service Level Agreement
SOAP	Subjective, Objective, Assessment, Plan
SOS	Smart Open Services
SPSS	Statistical Software for Social Sciences
SRO	Senior Responsible Owner
STDV	Standard Deviation
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
UK	United Kingdom
US	United States
UTAUT	Unified Theory of Acceptance and Use Technology
WHO	World Health Organization

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Chapter One: Introduction

1.1 Introduction

This chapter begins with a brief description of the challenges now facing healthcare settings and the potential role of Electronic Medical Record (EMR) systems. After defining EMR, and its components and stages, the chapter show Electronic Medical Records can support service delivery. This is followed by a detailed analysis of EMR stages, their adoption across the world, and problems which may be identified during the adoption process. Finally, the adoption of the EMR systems in Saudi Arabia is discussed as well as the significance of the study, its aims and objectives, and the study questions.

1.2 Background

Healthcare systems around the world aim to serve people well by offering the most appropriate healthcare services. However, rising costs and reduced funding are preventing healthcare organisations from achieving this goal, especially in developing countries (Altuwaijri, 2010; Peiró and Barrubés, 2012; Garcia-Subirats et al., 2014). This has placed great pressure on governments and health authorities to make significant changes in their healthcare delivery systems in order to achieve high quality, safe services that are sustainable (Khoumbati et al., 2006). Hospitals are complex organisations that need complex information management systems (Al-Yaseen et al., 2010) for the provision of effective and efficient services (Karim and Hussein, 2008). In the light of this, the adoption of robust information technology (IT) infrastructures is seen as one of the key solutions to support and maintain high-quality healthcare (Al-Yaseen et al., 2010).

The adoption of multifunctional IT systems in healthcare sectors can yield real benefits in terms of offering enhanced care delivery systems that are based on guidelines, enhanced monitoring and surveillance activities, a reduction in medication errors, and lower rates of potentially redundant or inappropriate care (Chaudhry et al., 2006). However, the high level of investment in the adoption of IT systems in hospitals, together with the complexity of the healthcare system itself, have resulted in the development of a large number of disparate and heterogeneous systems that are costly and difficult to integrate and manage (Kitsiou et al., 2009; Khoumbati et al., 2006). Most healthcare networks today run hundreds of disparate IT applications and this results in scattered patients' information across different systems and hospitals. These heterogeneous IT systems make it difficult for healthcare professionals to share vital medical information within the same hospital departments let alone across the hospitals (Altuwaijri, 2008; Altuwaijri, 2010).

Some potential limitations regarding the benefits of IT systems, such as reducing costs, have recently been discussed in the literature. For example, it has been argued that the effectiveness and potential return on investment of the adoption of IT systems in healthcare sectors remains unclear (Chaudhry et al., 2006). Thus, it is believed that healthcare organisations need to take a more business-oriented view of healthcare delivery, to identify the most appropriate organisational and information infrastructures to support care processes, and to pinpoint the challenges of integrating diverse IT systems (Grimson et al., 2000). However, creating better functioning IT systems in healthcare sectors requires, among other things, a comprehensive Electronic Medical Record (EMR) system that is available at the point and time of care (Hammond, 2005).

1.3 History of Medical Records

According to Luo (2006), a Medical Record is an account of the patient which contains information regarding presenting symptoms, with annotations from the physician and other health professionals detailing their observations, as well as discussions with the patient. As far as history is concerned, Medical Records are as old as medicine itself. One of the oldest recorded medical practices is that of ancient Egypt which developed some of the oldest forms of health records. Ancient Egyptians used carvings, drawings and symbols (known as hieroglyphics) on the walls of tombs and temples to document the medical history of the deceased. The hieroglyphics provided information about the illnesses, treatments and operations performed during the life of the deceased (Waters and Murphy, 1979).

However, the first, more formal, Medical Record was developed in the fifth century BC by Hippocrates who set two goals for such records. The first was that a Medical Record should accurately reflect the course of the disease while the second was that it should indicate the probable cause of the disease. These two goals are still valid and appropriate for medical records (Van and Musen, 1997). Similarly, Galen of Pergamon, a Roman physician of Greek origin, also made great contributions to anatomy and medicine and was known for documenting his observations about the care he provided for his patients (Nutton, 1990).

In the 1890s, hospitals became more organised and began to keep records of patients' admissions and discharges. Massachusetts General Hospital's records of admission started in 1821 and, over successive decades, many improvements in standards of professionalism were seen. The American College of Surgeons, which set high standards for surgical education and practice, was formed in 1913 as an educational association for surgeons. Its standards led the movement to maintain more comprehensive documentation of medical records (International Foundation of Employee Benefit Plans, 2003).

1.4 Definition of Electronic Medical Records (EMR)

Several terms for Electronic Health Records (EHR), such as the Electronic Medical Record (EMR), Computer-Based Patient Record (CPR) and Electronic Patient Record (EPR), are used interchangeably in the literature (Smolij and Dun, 2006). Owing to uncertainty about what exactly constitutes a Computer-Based Medical Record, several definitions of EHR have been presented in the literature. For example, Tang and McDonald define EHR as "*a generic term to describe a repository of electronically maintained information about an individual's health status and health care*" (Tang and McDonald, 2001). Burns (1998) defines EHR as "*a specific term used in Information for Health to describe a longitudinal record of patient's health and healthcare from "cradle to grave", based in primary healthcare & including periodic care, e.g., summaries from electronic patient records.*" The Healthcare Information & Management Systems Society (HIMSS, 2011) defines the Electronic Health Record (EHR) as "*a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports.*"

In an attempt to differentiate between EHR and EMR, the National Alliance for Health Information Technology (NAHIT) produced two different definitions. It defines EMR as "*the electronic record of health-related information on an individual that is created, gathered, managed, and consulted by licensed clinicians and staff from a single organisation who are involved in the individual's health and care*" while EHR is defined as "*the aggregate electronic record of health-related information on an individual that is created and gathered cumulatively across more than one health-care organisation and is managed and consulted by licensed clinicians and staff involved in the individual's health and care"* (Amatayakul, 2006). Likewise, Garets & Davis (2005) argue that EMR and EHR are not the same and represent different concepts. They define EMR as "*computerized clinical records generated in health care facilities and physician offices*" whereas EHR represents *"the capacity to share medical records among health care staff, patients, and sponsors of health care services*". Thus, EHR has more inherited problems than EMR, such as sharing patient information across different information systems in different hospitals, which can increase the risk to patients' privacy (McMullen et al., 2014). Since Saudi Arabia has not yet integrated its hospital systems (Altuwaijri, 2008; Alnuem et al., 2011), this research focuses on EMR, not EHR.

1.5 Components of an Electronic Medical Record System

There have been variations in recording the components of EMR data across the world. On the basis of studies that have explored this area, the following data components of EMR (as shown in Table 1) have been identified. These include: data concerning the presentation of complaints; past medical history; referrals; patients' lifestyle; physical examinations; laboratory and radiological tests; diagnoses, operations or surgical procedures; medication; and outcomes (Stratmann et al., 1982; Pringle et al., 1995; Schriger et al., 1997; Patel et al., 2000; Petersson et al., 2001). However, the National Institute of Health (2006) has comprehensively mentioned EMR's key components, as outlined in Figure 1and Table 1 and briefly mentioned below.

Figure 1: EMR components

Table 1: Key components of EMRs as reported in the literature

No	Studies	Components of EMR
1	NIH (2006)	Administrative system, laboratory system, radiology system, pharmacy system, CPOE, clinical documentation
2	(Petersson et al., 2001)	Referral, presenting complaints, physical examinations
3	(Patel et al., 2000)	Presenting complaints, past medical history, physical examinations, diagnoses, life style
4	(Schriger et al., 2000)	Past medical history, physical examinations, diagnoses, tests, treatment, discharge
5	(Ho et al., 1999)	Presenting complaints
6	(Schriger et al., 1997)	Past medical history, tests, discharge
7	(Pringle et al., 1995)	Referral, presenting complaints, physical examinations, diagnoses, tests, procedures, treatment, medication
8	(Stratmann et al., 1982)	Presenting complaints, physical examinations, tests, treatment, medication, admission nursing notes

1.5.1 Administrative System Components

The key components of EMR registration, admission, discharge and transfer data (RADT) are included in this category. Such data allow the health information of an individual to be aggregated in such a way that it can be used for research. The registration portion of an EMR contains a unique patient identifier, also known as the medical record number or master patient index (MPI). Advances in automated information systems have made it feasible to use these MPIs across organisations or institutions (National Institutes of Health (NIH), 2006).

1.5.2 Radiology System Components

Radiology Information Systems (RIS) contain data regarding orders, interpretations, patient identification information, scheduling, results, images and image-tracking functions. The Picture Archiving Communications System (PACS) is also used in conjunction with RIS which usually manages digital radiography studies (Ball et al., 2011).

1.5.3 Laboratory System Components

The laboratory system contains data regarding orders, results, scheduling, billing and other administrative information. It is usually a standalone system which is interfaced to the EMR. The integration of laboratory data to the EMR is limited because of complexity, even when the Laboratory Information System (LIS) and the EMR are produced by the same vendor. Sometimes users are given an access link for LIS within the EMR interface (System Review, 2005).

1.5.4 Pharmacy System Components

Pharmacy systems contain data regarding patient identification, prescriptions, alert system, expiry dates, stock management, billing and other administrative information. These systems are generally highly automated but typically are not necessarily integrated with EMRs. As Ondo and Jason (2005) reported, on average, 31% of all electronic pharmacy orders are re-entered in the pharmacy system.

1.5.5 Computerized Physician Order Entry

The Computerized Physician Order Entry (CPOE) enables physicians to send electronic orders to the pharmacy, radiology and laboratory services. It provides a wide range of functions such as alerting, customised orders, service ordering and reporting. There have been mixed experiences with such systems, including both major CPOE successes and failures. Handler et al. (2004) stated that CPOE has clearly demonstrated its ability to reduce medication-related errors; however, CPOE has been found to be too slow for some clinicians.

1.5.6 Clinical Documentation

Clinical documentation includes physicians' notes, nurses' notes, flow charts (vital signs, fluid balance and problem lists), preoperative checklists, discharge summaries, medical reports, advance directives, informed and general consent forms, health record tracking, releases of information, staff credentials and privileges, appointments, operation lists, deficient records tracking, and utilisation review and management. Although electronic clinical documentation systems enhance the value of EMRs, a successful implementation needs to coincide with a redesign of workflow. Furthermore, all stakeholders must buy into the implementation in order to ensure the achievement of its clinical benefits, which may be substantial; for example, as much as 24% of a nurse's time can be saved (Poissant et al., 2005).

1.6 Level of EMR Adoption and Capabilities

EMR itself is an environment consisting of various medical systems, such as a clinical data repository, clinical decision support system (CDSS), order entry, clinical documentation, etc. In order to gain a better understanding of the level of EMR adoption and capabilities in hospitals, and how the current systems within the EMR system relate to a specific level and stage, a categorisation scheme within an analytical model should be used (Jaana et al., 2012).

According to Bah et al. (2011), the most appropriate method indicated by many related studies to show the level of EMR capabilities and adoption in a nation is to use simple percentages in an analytical model. In this regard, according to Jha et al. (2009), most previous studies have either created their own analytical model (e.g., a consensus among experts to identify functionalities) or have asked questions concerning the presence or absence of EMRs. However, this produces different and sometimes contradictory results from one study to another (Jaana et al., 2012). Another method is to use an international analytical model that is used by many healthcare institutes and organisations worldwide, such as the HIMSS Analytics and Categorization Scheme (Bah et al., 2011). According to Jaana et al. (2012) and Bah et al. (2011), the HIMSS Analytics and Categorization Scheme is the most reliable method for assessing the level of sophistication of EMR capabilities within hospitals today and also helps in making international comparisons with regard to EMR adoption.

For the purpose of this research, the HIMSS Analytics and Categorization Scheme developed by Garets and Davis (2005) has been utilised. According to Jaana et al. (2012), HIMSS Analytics is a comprehensive categorisation scheme which permits hospitals with different applications to be classified at different EMR stages. HIMSS is an organisational body whose primary objective is to use information technology and management systems in the best way in order to improve quality, safety and cost-effectiveness in health care settings (Healthcare Information and Management Systems Society [HIMSS], 2006).

HIMSS Analytics consists of EMR stages based on the implementation status of various interrelated medical systems. Since it is difficult to understand the level attained by hospitals in terms of their electronic health records, HIMSS Analytics set up a categorisation scheme to evaluate the overall progress and the level of sophistication of clinical applications in hospitals, together with how they relate to different levels of EMR complexity. The HIMSS Analytics and Categorization Scheme consists of 31 medical systems to create seven levels or stages of EMR capabilities in hospitals (Jaana et al., 2012). Figure 2 summarises the stages of this scheme and illustrates each stage.

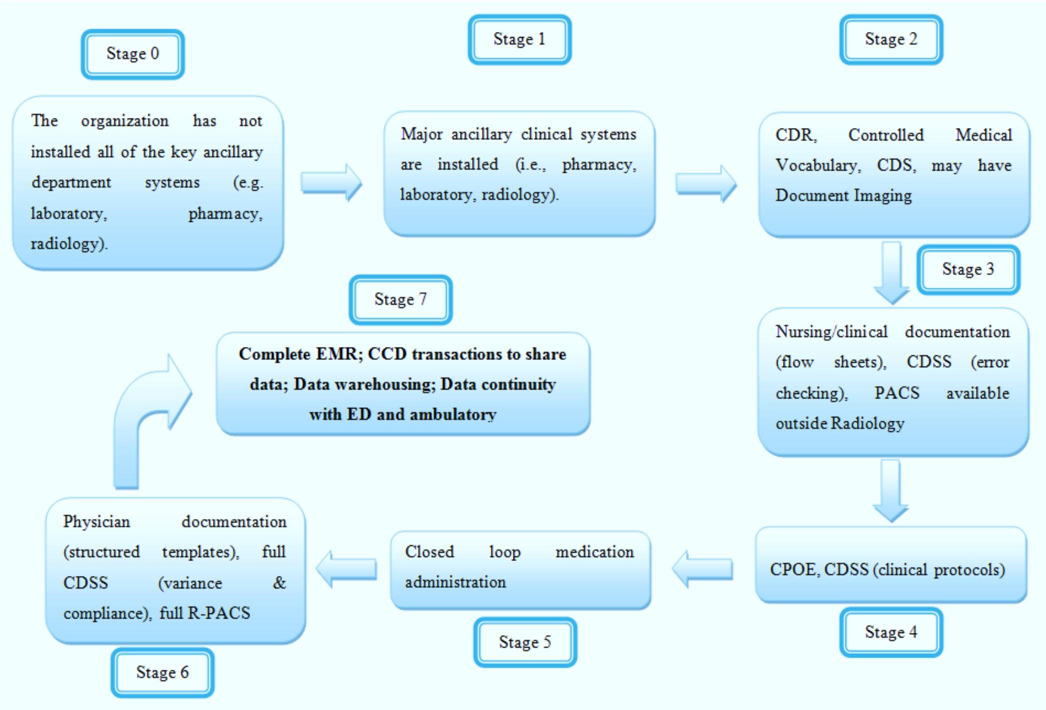


Figure 2: EMR implementation stages based on the HIMSS Analytics and Categorization Scheme (adapted from HIMSS Analytics 2011a).

1.6.1 Stage Zero

At this stage, a hospital or health care organisation does not have laboratory, pharmacy or radiology systems: i.e., any of the three key ancillary department systems.

1.6.2 Stage One

At this stage, a hospital or health care organisation has installed all three key ancillary department systems: laboratory, pharmacy and radiology.

1.6.3 Stage Two

At this stage, a hospital or health care organisation is supposed to have major ancillary clinical systems which feed data into a clinical data repository (CDR) that enables physicians to access and review patients' results and orders. A CDR has a controlled medical vocabulary and clinical decision support engine (CDS) with the help of which basic conflicts can be checked. At this stage, document imaging systems may also be linked to CDR for information sharing. It is also expected that a hospital or a health care organisation would be capable of health information exchange (HIE) and would be sharing information it holds with other patient healthcare stakeholders.

1.6.4 Stage Three

At this stage, a hospital or healthcare organisation should have nursing/clinical documentation (e.g. vital signs, flow sheets and nursing notes) which requires an Electronic Medication Administration Record application (EMAR). Such nursing documentation should be implemented and linked with a CDR for at least one inpatient service in the hospital. A care plan charting patients would score extra points. A hospital at this stage would also be expected to have a first level of clinical decision support to carry out checks for any errors within order entries (i.e., drug/drug, drug/food, drug/lab conflicts) which are usually found in the pharmacy information system. Picture Archive and Communication Systems (PACS) should also be available to physicians outside the department of radiology through the organisation's intranet so that they can access medical images.

1.6.5 Stage Four

At this stage, a hospital or health care organisation should be able to check all Computerized Practitioner Order Entries (CPOEs) so that any clinician licensed to create orders could add to the nursing and CDR environment; the second level of clinical decision support capabilities related to evidence-based medicine protocols should also be available at this level. If any inpatient service area is able to implement CPOEs with physician entering orders, then that organisation would be assumed to be at stage 4 (if all previous stages had been completed).

1.6.6 Stage Five

At this stage, a hospital or health care organisation ought to have closed-loop medication administration with an environment for bar-coded unit doses. In order to maximise the safety of patient care in the administration of medication, eMAR and bar coding or another auto identification technology, such as radio frequency identification (RFID), is required; this should be integrated with CPOE and pharmacy services. This enables the "five rights" of the administration of medication at the bedside to be verified by scanning the bar code on the unit dose of medication and the patient's ID.

1.6.7 Stage Six

At this stage, a hospital or health care organisation is expected to have full physician documentation with structured templates. Along with this, discrete data should be implemented for at least one inpatient care service area for the maintenance of progress notes, consultation notes, discharge summaries, problem lists and diagnoses lists. Guidance for all clinical activities related to protocols and outcomes in the form of variance and compliance alerts is provided by level three of the clinical decision support system. Additionally, an organisation at this stage is also expected to have a full complement of radiology PACS systems which provide medical images and transfer all film-based images to physicians via an intranet. An extra point can be achieved by having in place a cardiology PACS and document imaging.

1.6.8 Stage Seven

At this stage, a hospital or health care organisation ought to be paper free in managing and delivering patient care. The hospital should have patient information in terms of a mixture of discrete data, document images and medical images within its EMR environment. Clinical data should be analysed and used by a data warehouse to improve patient care and safety, as well as to improve the overall efficiency of services. Additionally, this clinical information should be readily available to share, through standardised electronic transactions (i.e. CCD), with other concerned persons involved in patient care, or via health information exchange (i.e. with other non-associated hospitals, ambulatory clinics, sub-acute environments, employers, payers and patients in a data-sharing environment). Hospitals and health care organisations should, at this level, be able to demonstrate summary data continuity for all hospital services (e.g. inpatients, outpatients, emergency departments, and with any owned or managed ambulatory clinics).

1.7 The Adoption of EMRs World Wide

1.7.1 Advanced Countries

In the following sections, the adoption of Electronic Health Records is described in leading countries of the world, such as the United Kingdom, other countries of the European Union, the United States and Australia.

1.7.1.1 The European Union

As far as other European countries are concerned, a high proportion of general practitioners (GPs) use Electronic Medical Records. According to one study, the percentage of GPs using Electronic Medical Records in Sweden, The Netherlands, Denmark, Finland and Austria was 90%, 88%, 62%, 56%, 55% respectively in 2001 (Interactive, 2001). However, these rates and the levels of adoption had changed radically by 2013 when, as illustrated in Figure 3, around 40% of hospitals in Spain were at Stage 5 and roughly all hospitals in The Netherlands were between stage 2 and stage 5 (51% & 33% respectively).

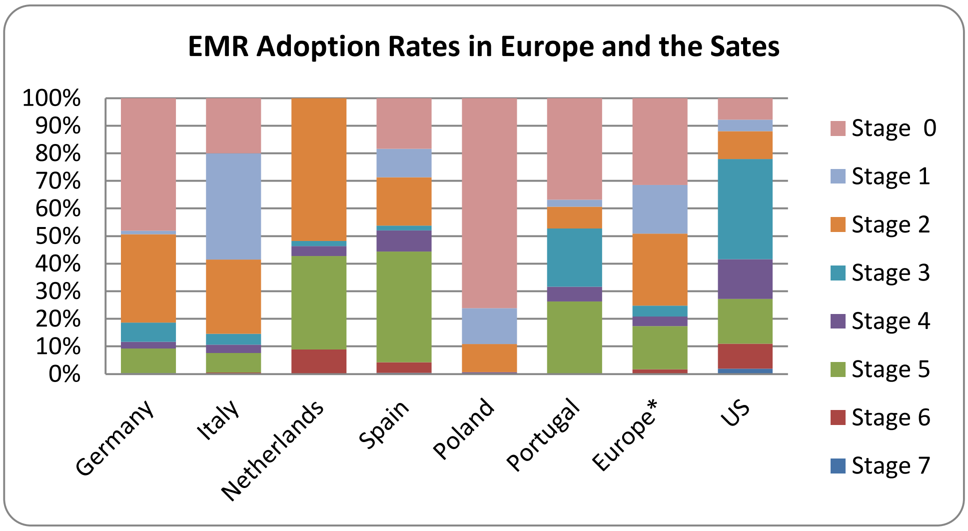


Figure 3: EMR adoption rates in Europe and the US

European countries have not stopped their EHR implementation at the level of integrating patients' information over local hospitals; they have also integrated patient information across Europe. The purpose of further implementation of EHR is to make sure that Electronic Health Record systems in the EU member states can interoperate and communicate with each other to offer health care providers across the EU with rapid access to vital patient information. The objective addressed by establishing features of EHRs is to allow vital patient information to be exchanged between systems; enable the sharing of health data; and build network systems that cover all areas of healthcare, while meeting operational, legal and training requirements (European Commission, 2008)

In order to develop cross-border EHR implementation, the European Commission launched two electronic health initiatives in twelve member states in 2004: (i) Smart Open Services (SOS) and (ii) Community eHealth Action Plan (2008). The Commission is aiming to achieve and maintain cross-border interoperability of electronic health record systems by the end of 2015 (European Commission., 2011).

According to the Commission, to achieve this, member states are being urged to undertake action at five levels: 1) political leaders should create the necessary regulatory and financial environment to make the eHealth infrastructure and services interoperable; 2) common domains and interfaces should be created to enable national domains to interact; 3) the development and use of technical standards and common interoperability platforms should be promoted; 4) common priorities and specific applications should be agreed upon; and 5) education and awareness must be improved for monitoring and considering all intended and related developments (European Commission, 2008).

One of the major obstacles hindering the achievement of the economic and social benefits offered by eHealth is the lack of interoperability of Electronic Health Record systems across the member states which have aggravated the existing eHealth fragmentation. The use of incompatible information and communication systems by member states has impeded and is continuing to impede access to the health information that is necessary for providing high quality and safe health care across Europe (European Commission, 2011).

1.7.1.2 United Kingdom (UK)

The UK is the biggest Electronic Patient Record (EPR) market in Europe, with $2.1bn expected to be spent on such technology by the end of 2015, following a 4.1% annual growth rate (Flinders, 2014). According to the Bloomberg report in 2013, the UK has one of the highest EMR adoption rates (97%), which is just behind Norway (98%) and The Netherlands (98%) (Robertson, 2013). However, this success has not come without problems.

In 1998 the NHS set the target to have EMR implemented in all its trusts by 2005; however, by 2002, only 3% of the trusts were found to have achieved the target (Hoeksma, 2002; Miller et al., 2005). Budget constraints and a lack of required IT standards were the main reasons for this low rate (Wanless, 2002). In response to this, the government allocated £2.3bn for a new national programme for information technology (NPfIT) (Department of Health, 2002).

This was considered the biggest IT programme in the history of the NHS due to its complexity and size. Its purpose was to develop centrally mandated electronic care records for patients so that nearly 30,000 staff could be connected to 300 hospitals and have secure and audited access to patients' records (Brennan, 2005).

The Office of Government Commerce (OGC) Gateway Process examines a wide range of projects and programmes to provide assurance that successful progress can be made. It uses independent external experts to examine the progress being made and the likelihood of the delivery of the programme or project being successful. A resulting review provides a valuable perspective on the issues being faced. The Health Gateway Process provides the NHS, and its Arm's-Length Bodies (ALBs) with free and confidential support using well established peer review and principles (DoH, 2011). Based on their concern about the infrastructure developed for the programme (Kable, 2009), the Gateway reviews produced for the NPfIT gave a red code, the worst status. Nine of the 31 reviews published by the OGC were given a red status, together with a call for immediate action to achieve success. Nineteen out of the 31 reviews gave the NPfIT an amber status, which means that the project should proceed whilst taking the OGC recommendations seriously. Only two of the 31 reviews gave the NPfIT a green status. According to reports published by National Audit Office (NAO) and the BBC in 2011, the NAO attributed the problems to many factors such as:

unrealistic ambitions, the complex nature of the NHS, and problems with technology (Triggle, 2011; NAO, 2011).

Although the NAO did not suggest the entire scheme should be scrapped, the BBC reported that some critics have called for such action. For example, on May 18, 2011, Tory MP Richard Bacon, a member of the House of Commons' Public Accounts Committee said: "This turkey will never fly and it is time the Department of Health faced reality and channelled the remaining funds into something useful that will actually benefit patients." Despite its critics, according to the BBC report, the Department of Health declared the project's potential capability to deliver value for money (Triggle, 2011).

1.7.1.3 United States (US) & Canada

In America, in an attempt to create an Electronic Medical Record system for most Americans by 2014, the US government established the Office of the National Coordinator for Health Information Technology in 2004 (Korin and Quattrone, 2007). Nevertheless, according to a recent survey published on the HIMSS website (2015), only 3.4% of the hospitals are completely paperless whereas nearly 4.4% of the hospitals are still using PBMR. Although progress seems to be slow, the results are considered significant in the light of the 19 billion dollars allocated by Congress for the adoption of EMR and other health information technology. The major barriers to the implementation of Electronic Health Records among US hospitals that did not have EMR included: financial limitations (73%), maintenance costs (44%), cultural barriers (36%), uncertainty about return on investment (32%), and lack of IT training (30%). The study shows that physicians' resistance and inadequate capital were the major barriers for hospitals seeking to implement EMR (Jha et al., 2009).

According to the "eHealth in North America" report, 69% of hospitals in the United States and 57% in Canada had adopted EMRs in 2013 (Borycki et al., 2013). In Canada, none of the hospitals are yet completely paperless but nearly 90% of the hospitals have partial EMR implementation and further efforts are being made by the Canadian government to extend its use (HIMSS, 2015).

1.7.1.4 Australia

According to the Bloomberg report in 2013, Australia is number five worldwide in terms of using EMR (Robertson, 2013). This development started in 2000 when the National Electronic Health Records Taskforce proposed the 'Health Connect' system, an IT system funded by the Australian government to allow the collection, storage and sharing of health information. The availability of complete and updated electronic health information that could be easily shared by care providers and patients was felt to help in decision-making and in the provision of seamless care. The objectives of Health Connect are to improve the effectiveness and efficiency of healthcare via electronic information, collected at the point of care, that can be accessed online and shared as needed. The government has established trial sites around the country to test the effectiveness of the Health Connect system and learn from these trials (Australian DoH, 2000). The Federal Enterprise Architecture Framework has set policies and standards for Electronic Health Records that include security, privacy, access control, data control, application and technology (Commonwealth of Australia, 2003).

In July 2010, the Computer Sciences Corporation (CSC) conducted an independent study of Australians' views of Electronic Health Records. The research found that consumers saw an individual Electronic Health Record as a basic Australian right and were waiting for the government to deliver it. The research also showed that Australians wanted to have personal control over their health records; they liked to know about its contents and who has access to it (Computer Sciences Corporation, 2010).

Australia has a plan for a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians. The Government will invest $466.7 million over two years in this (PCEHR) system and registration was due to be online from 2012-13. A draft "Concept of Operations" document was released to stimulate informed discussion with stakeholders regarding the characteristics, design, build and implementation of the PCEHR (Department of Health and Aging, 2011).

1.7.2 The Adoption of EMR in Developing Countries

Although there is a good deal of research in EMR in advanced countries like the UK, USA and Canada, few papers cover developing countries (Williams and Boren, 2008) while there are particular challenges for developing countries that may not be shared with developed ones (Avgerou, 2008; AL-ASWAD et al., 2013). For instance, in India, as studied in a single hospital, the major challenges to EMR were scepticism and a lack of computer skills (Scholl et al., 2011). These reasons might be relevant in interpreting the results of another study where researchers, using a motion study, found no evidence that EMR affected the speed of documentation processes between manual and computerised working (Shabbir et al., 2010). Nevertheless, in developing countries, EMR systems are perceived to facilitate effective and efficient data collection, data entry, information retrieval and report generation, and research (Williams and Boren, 2008).

There are other challenges that are shared by both developing and advanced countries. In Turkey, as an example of a developing country (McMullen et al., 2014), the top four issues with regard to implementing EMR are privacy, quality, security and the implementation of Electronic Medical Records (Turan and Palvia, 2014). Along with developed countries, EMR adoption has also been successfully undertaken in other less developed countries around the world. The WHO (2006) stated that two hospitals are now operating as paperless hospitals in Malaysia, while eleven hospitals in Korea and a number of hospitals in China are using some form of EMR. Similarly, hospitals in Asia are also in the process of adopting EMR technology (HIMSS, 2011b); a number of hospitals in South Korea, as well as in Singapore, have successfully implemented EMR systems and thus have set an example for other developing countries (HIMSS, 2011c).

1.8 The Adoption of EMRs in Saudi Arabia

In Saudi Arabia, about 60% of the health care services are provided by the Ministry of Health (MoH) whereas the remainder is provided by other government bodies such as the Ministry of Defence and Aviation, the Ministry of the Interior, the National Guard, university hospitals, and the rapidly growing private sector (Altuwaijri, 2008). Most Medical Record systems in the country are still Paper-Based, and even those which have started to use Electronic Medical Records have variations in terms of software and capabilities. Most importantly, most of the electronic medical services are not inter-connected. This situation has resulted in fragmented patient information, duplication of work, incomplete data entry, and negative effects on the quality, safety and cost of healthcare (Altuwaijri, 2008).

Due to the previous factors, satisfaction with EMR in Saudi Arabia is frustrating. In a case study conducted in Saudi Arabia, only 40% were satisfied with the system overall. The proposed predictors of overall satisfaction were: performance in the form of speed; integration with workflow; and the accuracy, completeness and timeliness of patient information (Alharthi et al., 2014).

Nevertheless, in recent decades, Saudi Arabia has made significant progress in the health sector with several hospitals receiving national and international accreditation, but EMR has not experienced equal progress. Since 2002, Saudi Arabia has shown great interest in adopting EHR to improve the quality of health care, enhance patient safety and reduce the cost of healthcare services.

As a result, in 2004, King Saud Bin Abdul Aziz University for Health Sciences (KSAU-HS) was created to support ICT in the healthcare sector. Year 2005 witnessed the establishment of the Saudi Association for Health Informatics (SAHI) to promote health informatics training and education and to support the implementation of the system throughout Saudi Arabia (Househ et al., 2010). Similarly, the Central Board for Accreditation of Healthcare Institutions (CBAHI), a national accreditation body, was established in 2007 to promote the quality of health services and increase the degree of safety through accreditation. CBAHI has developed standards for both manual and electronic medical records and information management (Central Board for Accreditation of Healthcare Institutions (CBAHI), 2010). Despite these efforts, the diffusion of IT applications in Saudi Arabia is still problematic because it is often associated with problems that are not only technical, but also cultural, political, economic, educational and social (Alshehri and Drew, 2010).

The Saudi MoH initiated a project in 2008 to automate 30 hospitals in different regions of the country, a project which included the creation of unified Electronic Medical Records. It was suggested that this project would save 10-15% of the annual health budget and was intended to pave the way for a unified EMR at a national level (Health Insights, 2011). Also, in 2010, the Saudi Ministry of Health launched its five-year eHealth Strategy for 2011-15 for the Kingdom of Saudi Arabia. The strategy consists of three phases: analysis and vision, strategy design and a strategic roadmap. The aim of the first phase is to understand the gap between the current and expected state of eHealth/ICT while the second phase will include the design of the strategic plan for eHealth/ICT. The final phase is to develop a five-year roadmap for the implementation based on findings from the first two phases (MoH, 2010).

Since then, although the MoH undertook initiatives to enhance EMR adoption in healthcare settings in 2008 and 2010, no study has explored the level of EMR adoption at a national level. However, a study conducted by Bah et al. (2011) evaluated the situation with regard to EMR adoption but only in the Eastern Province of the country and it collected information from only 19 hospitals out of a total of 244MoH hospitals. According to this study, only three of the hospitals had adopted EMR partially, and the level and extent of its usage was being undetermined despite the funding commitment of the government (Bah et al., 2011).

1.9 The Significance of this Research

Although there is a good deal of information regarding the overall status of EMR implementation in advanced countries, few studies have been undertaken concerning KSA hospitals. The literature indicates that no study to date has explored the current situation of EMR implementation at a national level in Saudi Arabia. What is known is that there is evidence of negative attitudes towards EMR systems. For instance, according to Alharthi et al. (2014), out of 220 physicians in one hospital, 40% of them were dissatisfied with the EMR. Moreover, 70% of those who did not want to return to a paper system wanted to change the particular EMR system. This begs the question as to whether this is because of the vendor or because of other factors. Furthermore, it is not known if this is also the case in other hospitals in Saudi Arabia. For instance, it has been found that more than three quarters of physicians in another hospital in the same area indicated that they felt that EMR had a positive impact on their work and the quality of care (Nour El-Din, 2007).

Therefore, this research aims to discover the level of EMR implementation in the Eastern Province of Saudi Arabia and to identify the main barriers and motivators affecting its implementation. Afterwards, three cases are studied in depth to find out what other factors may be hindering or motivating EMR implementation. Academics and practitioners who are devoted to the on-going use of EMR systems still lack a significant body of evidence with regard to the adoption and use of EMR systems in Saudi hospitals. Thus, the outcome of this research has significant implications for both academics and practitioners.

From an academic point of view, this research fills a gap in research knowledge while enriching and widening the literature concerning the adoption and use of EMR systems, in particular those in developing countries. From a practitioner's perspective, the findings of the study provide evidence-based knowledge for the MoH in Saudi Arabia regarding the current situation of EMR adoption and use; this could then enable decision makers to design suitable strategic plans and interventions for the adoption of EMR. In addition, the outcomes of this study could act as a reference for other strategic planners in the health sector in developing countries, as well as being used to promote the adoption of EMR systems in those nations.

EMR is not a goal in itself (Iakovidis, 1998) but a tool for supporting the continuity of care and, consequently, the quality, accessibility and efficiency of healthcare delivery. Hence, the adoption of an interoperable birth-to-death EMR system can make a significant contribution towards achieving a sustainable health system (Hovenga, 2008). Additionally, according to a comparative study carried out by Thakkar and Davis (2006) and based on hospital size of the risks, barriers and benefits of EMR, EMR systems could save billions of dollars in healthcare costs annually while maintaining healthcare quality.

Although EMR offers many benefits, there are difficulties associated with its implementation, and about 50% of EMR implementation initiatives have failed (Gleason and Farish-Hunt, 2014). In developing countries such as Saudi Arabia, physicians' satisfaction with EMR is only 40% (Alharthi et al., 2014). In other words, making the transition from Paper-Based Health Records (PBHR) to EMR in a healthcare setting takes time (Delpierre et al., 2004) and certain factors may affect the time required for such a transition. These include: the availability of financial support, uncertainty about the return on investment, the existing standard of technology, and the level of resistance to and priority of change (Dick et al., 1997). Although some studies have explained these factors in different contexts, as explained in the literature review, it is not clear in the Saudi context why some hospitals achieve a higher level of EMR implementation than others.

1.10 Research Questions

In order to fill these knowledge gaps, certain questions need to be addressed and answered by this study. These are as follows:

1. What stages has the adoption of EMR systems reached in Eastern Saudi MoH hospitals, based on the HIMSS model?
2. Why does a hospital upgrade from one stage to a higher one?
3. Why does a hospital downgrade from one stage to a lower one?
4. Why do the hospitals vary in terms of their EMR implementation stages?

1.11 Aims and Objectives of the Study

The main aims of this research are to investigate and evaluate the adoption process of EMR systems in Eastern Saudi MoH hospitals. In order to fulfil these aims, the following objectives have to be achieved:

Objective 1: Based on the HIMSS model, to identify the current stages reached in the levels of adoption of EMR systems in Saudi MoH hospitals in the Eastern governorate.

Objective 2: To identify the success factors influencing the adoption and use of EMR systems in Saudi MOH hospitals.

Objective 3: To identify the challenges facing the adoption and use of EMR systems in Saudi MOH hospitals.

Objective 4: To develop an implementation framework to support the adoption and spread of EMR within the country

Chapter Two: Literature Review on Factors affecting the adoption, diffusion and further implementing EMR systems

2.1 Introduction

This chapter presents a review of the literature concerning EMR and provides a critical analysis of the theories explaining its diffusion. Its aim is also to understand the factors that could lead to organisations proceeding with EMR implementation. Therefore, after a brief history of the evolution of EMR, literature outlining the potential advantages of the EMR over Paper-Based Systems is presented because benefits are usually the main drivers for implementing any system. However, without adopting certain critical success factors, these benefits will not be realised. Therefore, before summarising the chapter and illustrating the knowledge gaps, the research framework is presented as a focus for the data collection explained in later chapters.

2.2 The Evolution of Electronic Medical Records

There have been some modifications to the overall structure and content of EMRs over the years. According to Häyrinen et al. (2008), three different types of EMR structures have been observed previously (as shown in Table 2). The first type of structure was the "time oriented electronic medical record" in which a patient's information was gathered in terms of the occurrence or time of his/her disease, with the most recent disease event being recorded at the top of his/her record. The second type of EMR structure was the "problem oriented medical record (POMR)". In this type of EMR structure, the patient's information was presented under the heading of his/her disease or condition: e.g. tuberculosis, myocardial infarction, etc. Furthermore, under each heading (disease/condition), the patient's information was shown in terms of subjective information, objective information, assessment and plan (SOAP). The third type of EMR structure was the "source oriented record". In this type of structure, a patient's information was presented on the basis of what information had been collected: e.g. blood tests, X-ray reports, visits to doctors, etc. Under each heading, data were presented in terms of time: for example, the most recent data were presented on top.

Averill (1998) also reported another framework for nursing documentation being used by the American Nursing Association (ANA). The structure of this documentation is similar to the structure of SOAP. The nursing documentation includes four stages: assessment of the patient's condition, diagnosis, proposed/given interventions, and outcomes. Similarly, Ehrenberg (2003) mentions that the structure of Swedish nursing documentation is based on the key words of the Swedish model for nursing care. This model has four major concepts of nursing: well-being, integrity, prevention and safety.

Today, as illustrated in Table 2, the structure of EMRs is a combination of all three structures previously in use (Häyrinen et al., 2008). Both free text and coded data are used to record information in EMRs, along with different types of classification, vocabularies and codes, which are used to describe the diagnosis of patients, procedures, interventions and outcomes. The classifications include, for example, the International Classification of Diseases, Current Procedural Terminology, the Anatomical Therapeutic Chemical Classification Index, the Iowa Nursing Outcome Classification, etc. (Averill et al., 1998).

Table 2: Structure of types of EMR

Structure of types of EMR	Description
Time Oriented Electronic Medical Record	Chronological presentation of patients' disease information
Problem Oriented Medical Record (POMR)	Presentation of patients' information under a disease heading
Source Oriented Record	Presentation of patients' data on the basis of the source of information: e.g. blood test
Recent EMRs	Combination of the three above

2.3 The Adoption of EMRs

Health IT systems have the potential to reduce health care costs, improve efficiency, and enhance the quality of care and patient safety (Hammond 2008). While the interest in EMR adoption is high (HIMSS, 2014), the actual rate of adoption still remains low in many countries (Simon et al., 2007). Many countries have launched national programmes to move towards a single shared EMR for patients and to connect general practitioners and hospitals (Hendy et al., 2005; Hendy et al., 2007; Currie and Guah, 2007). One of the main initiatives of these national programmes is to study in depth the different challenges facing the adoption of EMRs in those nations (Gagnon et al., 2010).

In Saudi Arabia, little is known regarding the adoption of EMRs, and in particular within MoH hospitals, owing to the lack of studies and government roles (Altuwaijri, 2008; Bah et al., 2011). According to the few papers concerning health IT systems in Saudi Arabia (e.g., Alkraiji et al., 2011), there is a current need for such studies to assess the levels of EMR capabilities and adoption within Saudi hospitals. In the context of Saudi Arabia, the concept of EMRs is relatively new and therefore requires more attention (Bah et al., 2011; Alkraiji et al., 2011).

However, one of the major challenges in identifying the level of EMRs and their use is the lack of consensus on what constitutes EMR capabilities (Jaana et al., 2012). Differences in the definitions used regarding EMRs and methodological issues in previous studies in the literature might explain some variations in the EMR adoption rates in some countries, such as the US or European countries (Jaana et al., 2012).

Concerning the processes of EMR adoption, many studies in the literature were found to have taken different research approaches and to have provided different explanations (Vishwanath and Scamurra, 2007). Most of these studies were based on Rogers' sociology model (2010) for the adoption of technological innovations to explain the adoption of EMRs (Vishwanath and Scamurra, 2007). Rogers' theory (2010) explains how individuals or groups learn about innovations and thereafter make a decision either to adopt or reject them.

This theory defines five innovation characteristics that might influence the adoption of any new technology. These generic and very broad characteristics are widely prevalent across technologies (Vishwanath and Scamurra, 2007). In addition, previous studies have often subsumed factors into a single one of the five generic innovation characteristics, which reduces the possibility of clearly measuring and understanding the complete effect of each factor (Vishwanath and Scamurra, 2007). Furthermore, every social situation is conditioned by interacting variables, such as time and culture, and therefore no two situations are identical (Irani, 1998). For example, early research into health IT adoption found other factors beside the five broad generic innovation characteristics of Rogers' theory (2010), such as the role of the hospital and environmental factors (e.g. a hospital's scale and ownership), in taking decisions regarding the adoption of technology (McCullough, 2008).

Recent studies have reported several issues associated with the adoption of EMRs. For example, governance strategies can successfully address certain issues associated with the adoption of EMRs, such as cost and the security and privacy of patient data, issues which might, in other circumstances, act as barriers to the adoption process (Blendon et al., 2004). Vishwanath and Scamurra(2007) explained a variety of factors attributed to the low rate of EMR adoption. These included macro-level factors (e.g., a lack of national policy and a lack of informatics standards) and micro-level factors (e.g., perceived complexity and resistance from physicians).

2.4 EMR versus Paper-based Medical Records (PBMRs)

A Patient Record is defined as *“An amalgam of all the data acquired and created during a patient’s course through the* health-*care system*" (Tang and McDonald, 2001, p.327). Different names are and have been used by different countries to describe patients' records. Some of the most commonly used names are health records, patient records, patient health records, patient medical records, patient charts and patient clinical records. In contrast to EMR, the Paper-Based Medical Record (PBMR) is generally one where medical data pertaining to a patient are written on paper (forms) and organised in one folder under a unique hospital number.

Today, the management of large amounts of patient information in medical practices have made the medical record the cornerstone of communication and documentation (Luo, 2006). This patient information was stored entirely in a Paper-Based form of Medical Record until the early 1960s when the idea of an Electronic Medical Record was introduced (Blumenthal and Tavenner, 2010). Advocacy for the wide implementation of Electronic Health Records has been seen in the last two decades although Paper-Based Medical Record systems are still widely used in health care settings today (Luo, 2006). In the following sections, the advantages and disadvantages of Paper-Based Medical Records and Electronic Health Records are analysed.

2.4.1 Advantages of *PBMRs*

PBMRs have been used for recording patient clinical information for centuries. Besides providing information for health care providers, this information was used for medical education, research, quality reviews, and for management (American Health Information Management Association, 2010).Such a system is still by far the most common method of recording patient information for most hospitals and practices in the United States (Jha et al., 2009).

Dick et al.(1997) state that physicians and other medical staff are very familiar with existing PBMR systems and it is routine for them to record soft and subjective clinical findings in files. Similarly, Jha (2009) states that, when interacting with patients, most physicians find it very easy to make Paper-Based Medical notes. Patients' information being stored in the form of PBMRs at a healthcare facility creates a sense of ownership for the healthcare providers and also increases the sense of security with regard to the information. Similarly, there is no risk of the system crashing or becoming infected with computer viruses; hence, there is no risk of sudden data loss (Dick et al., 1997). Apart from this, in some countries (e.g. Germany), the legal system treats PBMRs on a priority basis; insurance companies in particular evaluate the appropriateness of admission and the length of stay of a patient by using the PBMR, which increases its credibility (Stablein et al., 2003).

2.4.2 Disadvantages of PBMRs

Although the PBMR is easy and flexible from the users' point of view, as illustrated in the previous section, certain disadvantages have been reported in the literature. Dick et al. (1997) state that the PBMR can be a source of poor documentation, ambiguous data, illegible handwriting, fragmented patients' health information, and poor availability. Similarly, Roukema et al. (2006) state that paper-based medical records often accumulate over time and become bulky, implying the need for extensive storage facilities and staff. Moreover, the large amount of patient information created during healthcare processes aggravates the problems of maintaining such records.

Along with this, illegible handwriting is another issue that causes serious errors such as misinterpretations of physicians' orders, and errors in dispensing or administering medication (Jayaram et al., 2011a). The importance of appropriate handwriting and legibly written prescriptions has increased tremendously, especially after the publication of the report by the United States Institute of Medicine (IOM) entitled "*To Err is Human*" which highlighted that between 44,000 and 98.000 people die in the United States annually because of medical errors. Some of these deaths occurred as a consequence of the illegible handwriting of doctors (Kohn et al., 2000).

Liaw (1998) highlighted another aspect of PBMRs: that patients' information being kept in bits and pieces at different locations increases the cost of patient health care. Because of this, the Institute of Medicine (2001) in its report "*Crossing the Quality Chasm: A New Health System for the 21st Century*" described the American health system as "*a tangled, highly fragmented web that often wastes resources by duplicating efforts, leaving unaccountable gaps in coverage, and as failing to build on the strengths of all healthcare professionals*" (Institute of Medicine, 2001). Roukema (2006) has argued that while PBMRs continue as a means for recording patient health information, these disadvantages will have a negative impact on patient safety and will impede the quality and continuity of health care.

2.4.3 Advantages of EMRs

The ultimate goal of hospitals is to offer high-quality patient care and the EMR has been found to be one of the strategic vehicles to realise this aim. Hence, in one study, physicians stated that they felt that the EMR improved the quality of the care they delivered to their patients, particularly because it helped them to track patients (Boas et al., 2014). The potential of information technology to provide many benefits to the healthcare industry has been widely acknowledged and policy makers in many countries advocate the implementation of EMR systems (Blumenthal and Tavenner, 2010). This desire is based on the findings of many research studies that suggest EMRs promise considerable benefits to health care. For example, such potential benefits might include: reduced medication errors, reduced lengths of stay, reduced cost, improved documentation, better communication between care providers, and the availability of treatment options even to visitors (Rothschild, 2004; Poissant et al., 2005).

Similarly, McCoy et al. (2006) conducted a survey regarding EMR and identified many benefits which stemmed from the presentation and exchange of patient information electronically with other departments (e.g. the pharmacy, laboratory, radiology departments, etc.) within a healthcare organisation. Many research studies have suggested promising benefits of EMR to health care. For example, Burns (1998) mentioned three main benefits offered by the EMR: the integrity of data that cannot be misplaced or lost, an integrated and permanent patient record, the implementation of screening and other preventative measures.

Likewise, according to a recent study by the European Commission (2011), electronic health records and electronic prescribing systems can provide great socioeconomic benefits that will exceed their high costs although such benefits may take a long time to materialise. The report also notes that financial benefits can be achieved through expertise in resource management and organisational change. The report identifies interoperability as a key to facilitate data access and achieve the aforementioned socioeconomic benefits of the electronic medical record systems. It concludes: "*Investment in such systems is worthwhile and justifies their net financial boost*" (European Commission., 2011).

2.4.3.1 Patient safety

Patient safety is one of the most prominent reasons for using EMR as it can produce significant reductions in medical errors (Anderson, 2007). The findings of a research study conducted during a period from 2003 to 2007 and published in the Journal of Psychiatric Practice showed that the use of EMR reduced medical errors by 87% (Jayaram et al., 2011a). There are many approaches to explain how EMR could enhance patient safety. The SEIFPS (Systems Engineering Initiative for Patient Safety) framework, which is based on Person, Tasks, Tools & Technologies, Physical Environment and Organisation (Carayon et al., 2006), helps in understanding how EMRs can enhance patient safety (Carayon et al., 2014). Moreover, the EMR is suggested to be the most appropriate technology for decreasing errors that might occur in tasks carried out by a responsible person (e.g. a pharmacist), thus enhancing patient safety (Carayon et al., 2014).

2.4.3.2 Effectiveness

Like safety, effectiveness means matching care to science, thus avoiding overuse, under use and misuse. EMRs have the potential to improve patient outcomes, quality of care and patient safety (Hunt et al., 1998; Kaushal et al., 2003). For instance, it has been found that EMRs increased the utility of blood tests through a period of time by enabling enhanced tracking of a patient's progress in an accurate and efficient way (Skrøvseth et al., 2015). The findings of a systematic review found that EMRs were successful in supporting clinical decision-making at the point of care and during physician workflow, and in providing computer-based decision support (Kawamoto et al., 2005). Similarly, EMRs enhanced decision making for anaesthesia since such systems allowed significantly more records to be completed on time than a manual system (Jang et al., 2013). Bates et al. (2003) suggested that clinical decisions in ambulatory care settings are most effective when EMR is used and information is accessed during patients' visits. It has been claimed that EMRs have a positive impact on preventing medical errors and there is a good deal of evidence that they improve safety (Greenhalgh et al., 2010). According to Jones (2010), the quality of care increased for some types of serious medical care when a basic EMR was available.

2.4.3.3 Patient-centeredness

Patient-centeredness means involving patients and their families in care decisions and respecting their choice. The term "patient-centred" has become a prominent term in health care policy and publications. The EMR also plays an important role in ensuring patient centeredness by providing access to medical information, and by involving patients and their families in care decisions (Dimick, 2011). It is important, therefore, to explore the functionality and technical features of an EMR that support this approach to health care delivery.

Apart from playing a supporting role for physicians in patient-centred health care, little is known about what an EMR can do to enhance patient-centred care. There is little evidence which describes the types of health information technology systems that can improve the engagement of patients in the care provided to them. For instance, Kamal et al. (2014) advised that physicians should use evidence-based benchmarks for Diabetes 2 management as the EMR system enabled physicians to understand a patient's history, thus predicting the progression of the patient's status.

Furthermore, patient-centred care supports effective communication between patients and their care providers, provides access to information when needed, and allows care to be coordinated among different providers (Dimick, 2011).

2.4.3.4 Timeliness

Timeliness means reducing waiting times for both patients and care providers and EMRs have great potential to decrease waiting times significantly. Riverpoint Paediatrics in Chicago (US) decreased waiting times for all encounters by 40% while the time taken to reissue prescriptions decreased significantly from 48 hours to 15 minutes and the time staff and physicians took to answer inquiries decreased from 24 hours to just 15 minutes. Cooper Paediatrics in Duluth, GA, decreased waiting times for medication reissue by 42% and turnaround phone call times dropped by 75% (Healthcare Information and Management Systems Society [HIMSS], 2006).

2.4.3.5 Efficiency

Efficiency concerns reducing waste and the use of EMRs can result in significant decreases in cost. According to the HIMSS, Riverpoint Paediatrics reduced the number of claims due to errors in coding and increased collection rates from 52% to 88% while insurance payment times dropped from 60 days to 15 days. Southwest Texas Medical witnessed raised charges per patient encounter from $171 to $206 and the clinic's total billable hours increased by $2.1 million, while collections raised $1.4 million a year after implementation. An implementation of electronic health records allowed Evanston North-western to save $4 million by reducing the number of full-time workers; it also saved another $10.5 million by adding archiving and communications services to the system. Moreover, the EMR system allowed savings of another $1.94 due to the decreased use of paper forms (Healthcare Information and Management Systems Society (HIMSS), 2006). According to HIMSS, Paediatrics at the Basin, which is devoted to caring for babies, children and adolescents in the Rochester area, saved $4 per chart request, totalling approximately $16,800 per year as a result of paper charts no longer being used in the office. The clinic saved about $30,000 annually on personnel costs and $5,000 by eliminating chart storage costs (Healthcare Information and Management Systems Society (HIMSS), 2006).

2.4.3.6 Equity

Equity means eradicating ethnic and racial distinctions in health status. The impact of EMR on equitable health care services has not yet been explored. Equitable health care means the creation of patient-centred systems of care that are responsive to patients' expectations, needs and contexts (Epstein et al., 2010). Improving equity requires there to be a fair and equal allocation of health care resources according to patient needs, especially for those who have previously been underserved (Fiscella and Shin, 2005). EMR can have a positive impact on equity by improving access, reducing costs and producing rich data to inform policymakers, helping them to address health care disparities.

2.4.4 Disadvantages of EMR

Before discussing the disadvantages of EMRs, it is worth mentioning that the benefits of EMR are limited by many factors, such as lack of awareness, a lack of availability of EMR functionality, or poor EMR data quality (Price et al., 2013). Additionally, certain disadvantages of implementing electronic medical records have been found in the literature (Tierney et al., 1993; Bates et al., 2003; Jones et al., 2010). Based on a summary of the literature review, Figure 4 shows the six main disadvantages of EMR systems.

Firstly, the cost of the system and its implementation could be prohibitive for many hospitals. Secondly, once it is implemented, administrative time is wasted on data entry and adapting processes to fit in with the new system. Thirdly, after implementation, the system may not be agile enough to offer flexibility to the organisation while, fourthly, there may be privacy issues, especially in emergencies, when patient information may be shared in chaotic way or data may be leaked because of the centralisation of the data. Fifthly, hospitals have been exposed to new technical risks since using technology. Lastly, more recently, the heavy use of EMRs has decreased the time spent in face-to-face communication with customers; this has decreased the feelings of empathy of nurses towards patients.

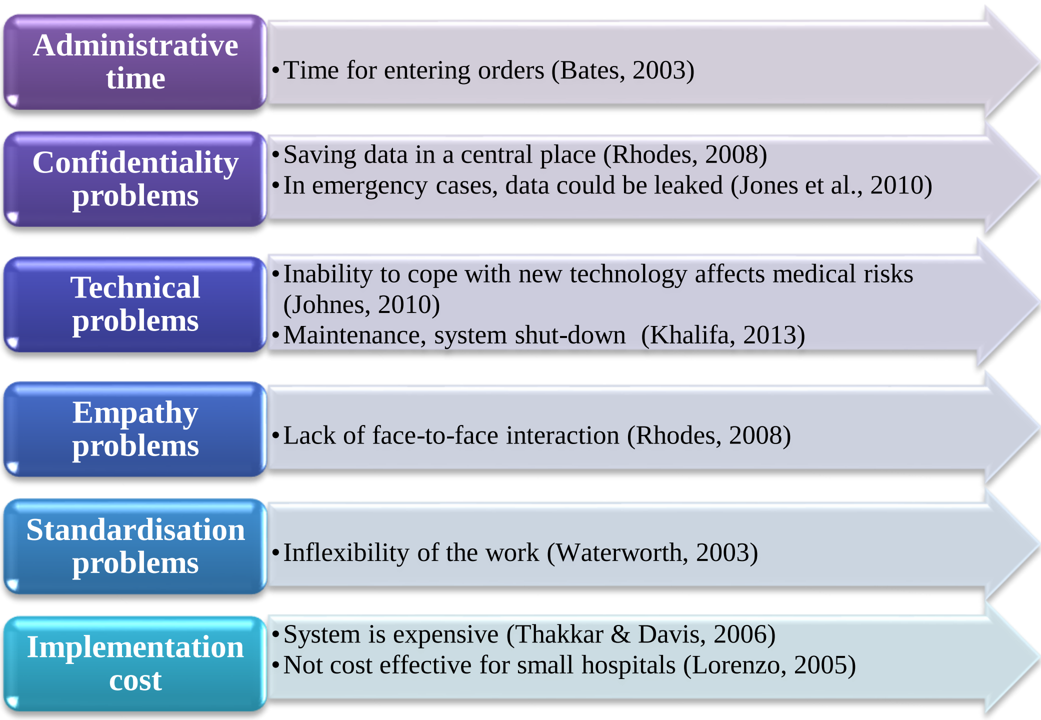


Figure 4: Synthesis of the literature review regarding the disadvantages of EMR

2.4.4.1 Implementation costs

It has been claimed that the implementation of EMRs is cost effective (Healthcare Information and Management Systems Society (HIMSS), 2006). This may be true for hospitals and physicians' offices that are financially sound. However, small hospitals and small offices of physicians are lagging behind in the implementation of EMR because of cost (Thakkar and Davis, 2006; Moreno, 2005). Similarly, a large IT industry trade group from the US observed that there is a huge initial cost of EMR implementation along with lost productivity during its implementation phase, especially for smaller practices. Moreover, there is also currently a question mark over its usability which is responsible for the low adoption rate of EMR among physicians in the US (Dell, 2012).

2.4.4.2 Administrative problems

Even after implementing the system, there may be administrative problems. Some studies have reported that physicians spend more time entering orders on electronic order entries than they used to spend on PBMRs which causes delays in the provision of services to patients (Tierney et al., 1993; Bates et al., 2003). Similarly, as is the case with all electronic devices, systems being used in healthcare settings may have 'down time'; that is, they are not working when they are required.

Not only administrative problems, but also exposure to new technology that affects medical risk is another disadvantage of EMRs. Although EMRs improve certain safety aspects by different means, as explained in the previous section, safety is also decreased when systems are highly advanced or newly adopted. For example, hospitals that were upgrading their electronic health records to a more advanced system saw a decrease in the quality of care for heart attack patients and for heart failure patients by 1.2% and 2.8% respectively (Jones et al., 2010). This situation has been justified by stating that the introduction of complex technologies into healthcare work environments that are already very complex may trigger certain unintended staff reactions that could outweigh the potential benefits of the new technology.

2.4.4.3 Technical problems

Technical problems are not limited to exposing users to new advanced and complex systems, but also include other tangible technical problems such as maintenance, repairs, system shutdown, and other IT related problems (Khalifa, 2013). All of these technical problems contribute to EMR failure and lead to dissatisfaction and feelings that the system is unreliable (DeLone and McLean, 1992; Delone and McLean, 2002; Petter et al., 2008a).

2.4.4.4 Privacy problems

Privacy problems are another concern. These can be a threat to timely access to a patient's information, especially in an emergency, and this can make the patient's condition worse (Thakkar and Davis, 2006; Anderson, 2007). According to the National Archives and Records Administration (NARA), a lack of standards over sharing information is another major problem with EHR systems. Under legislation concerning data protection, it is the responsibility of the creators and custodians of health records, such as a health care facility or provider, to keep the records in an unaltered and authenticated form (NARA, 2008). However, large scale breaches in these confidential records have been brought to the attention of users. According to Kate (2010), a radiologist, with the help of a stolen password, allegedly accessed the records of hundreds of patients at Griffin Hospital, Derby, and downloaded information about 339 of them. Consequently, major concern has been raised by the public regarding the security of their personal data.

2.4.4.5 Problems regarding empathy and inflexibility

Empathy and inflexibility problems because of EMR implementations have also been raised. Rhodes et al. (2008), for example, highlighted a very important aspect of EMR use. According to the authors, the use of computers by clinical staff during face-to-face consultations with patients, and an overreliance on a checklist agenda on a computer, is no good in terms of creating the positive interpersonal relationships that are essential for the successful treatment of a patient. This type of procedure leaves very little room to address patients' concerns that fall outside the remit of the checklist and this reduces clinical staff's opportunities to use their own therapeutic and communication skills (Rhodes et al., 2008). According to Waterworth (2003), nurses manage the demands of heavy workloads with the help of "routinisation" and using a computer checklist is one way to routinise tasks. However, Rhodes (2008) strongly argued that effective patient care should involve something more than meeting the aims and objectives of bureaucrats.

2.5 Frameworks which Explore the Spread of Electronic Health Records

Although there has been more than three decades of experience in implementing electronic health records, uptake is less than 20%, even in the US and Canada, and almost 50% of implementations fail. In the literature, a range of different frameworks explain EMR diffusion and uptake. These include: Socio-technical models (Golden and Martin, 2004); Technology Acceptance Models (Venkatesh and Davis, 2000a; Tavakoli et al., 2013; Marler et al., 2009; Kowitlawakul et al., 2015; Seeman and Gibson, 2009); and Information Systems Business Success Models (Delone and McLean, 2002; DeLone and McLean, 1992; Petter et al., 2008a; Badewi et al., 2013). However, none of these frameworks provides a clear theory to explain the motivational factors behind proceeding with an EMR implementation. In this section these frameworks are briefly and critically analysed in order then to use them in attempting to understand the cases and as a foundation for this research framework.

2.5.1 Socio-technical Models

Berg et al. (1999) proposed a socio-technical model for patient care information systems (PCISs) by emphasising the importance of sociological insight in the development and evaluation of these systems. According to this, users are central to ensuring the success of any implementation of technology. Although this process is politically textured, more importantly, it highlights the potential role of IT in healthcare settings. To maximise the utilisation of technologies, it is important to recognise the interdependence of the system's functioning, as well as the skilled and practical health care professionals who will use it. The socio-technical approach does not offer simple solutions to existing problems; however, it helps in facing the challenge and recognises that such technology may change the structure and shape of current health care settings.

On the other hand, other researchers have not focused on the health care settings; they have emphasised the importance of the interrelationships among people, processes and technology in the improvement of performance (Curtis et al., 1995). The People Capability Maturity Model SM (P-CMMSM) was developed to guide organisations when making improvements by addressing people-related issues (Curtis et al., 1995). This model provides a maturity assessment framework to improve, on a regular basis, the management and development of the human assets of software or an information system. It also provides guidance about the management of the staff skills required to improve progressively their software development capability.

Likewise, Golden & Martin (2004) proposed a star model with six inbuilt ideas which are related to human resources, organisational structure, incentives, strategy, information and decision-making, and culture and value. This model provides guidance as to how systems work and how they can be designed and redesigned through the allocation of a decision-making authority and accountability.

Although these theories explain the role of the environment or setting, and the relationship between people, processes and technology, these theories do not consider in depth the attitudes of the users (Ajzen and Fishbein, 1977; Fishbein and Ajzen, 1975; Ajzen, 1991). However, the users' attitudes toward the system are the cornerstone of change management (Kotter, 1995). Therefore, technology acceptance models were designed in response to this weakness since they offer another perspective with regard to the diffusion of technology and could be a focus for understanding the motivational and de-motivational factors affecting an EMR implementation.

2.5.2 Technology Acceptance Models (TAM)

Thus, since attitude is a key driver to motivate users to use a system, the Theory of Planned Behavior (TPB) focuses on the factors that affect the intention to use (Ajzen, 1991). Hsieh (2015) extended this model to consider organisational trust and perceived risk as factors affecting the intention to use EMRs. Although the TPB & TAM (the TPB version but applied to ICT projects: Davis et al., 1992; Davis, 1993) spotlight the role of perception in the diffusion of the use, they do not explain other factors that affect this perception or how this affects a user's attitude (Seeman and Gibson, 2009). In addition, intention to use alone is not sufficient to understand the motivations and de-motivations affecting the further implementation of a system. However, it could help in understanding some aspects of socio-technical factors in terms of perceptions regarding ease of use and perceived usefulness.

According to Davis (1989), the Technology Acceptance Model (TAM) is an information systems theory which discusses how users accept a technology and start using it. He asserts that, when a new technology is introduced to users, there are a number of factors which influence "how and when" users will start using that respective technology. These factors are termed "perceived usefulness (PU)" and "perceived ease of use (PEOU)". In other words, the medical staff who perceive that the EMR is easy to use, aligned with their professional norms, supported by their co-workers and patients, and able to demonstrate tangible results, are more likely to accept this new technology (Gagnon et al., 2014). Likewise, researchers found that, see for example Figure 5, the TAM explains that attitudes towards a system are determined by the perception of usefulness and ease of use (Tavakoli et al., 2013; Aldosari, 2012; Ahlan and Ahmad, 2014).

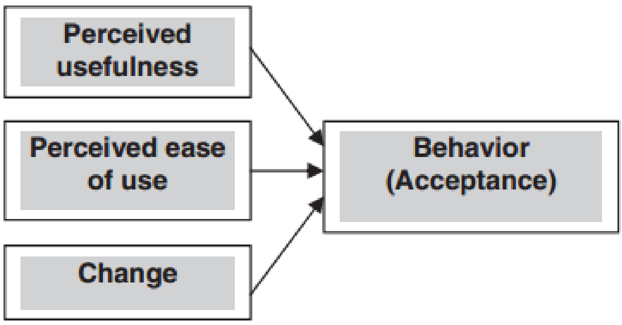


Figure 5: TAM in an EMR implementation (adapted from Aldosari, 2012)

Others have used the same model but have considered more concepts, such as the "self-efficacy" of the users, and their impact on perceived usefulness and ease of use (Kowitlawakul et al., 2015). Other researchers have considered more concepts by using the extended version of TAM, the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2012b). This version includes factors such as effort expectancy and facilitating conditions to explain the intention to use EMR (Maillet et al., 2015).

2.5.3 Information Systems Success Model

Unlike the TAM theory which focuses on use behaviour, Delone & Mclean (2003) developed another framework to consider more concepts in understanding the success and diffusion of IT projects in general. The success of IT projects is determined by perceptions of their net benefits, not by their use. However, use behaviour is a key factor in realising the benefits. According to Petter et al. (2008a), as illustrated in Figure 6, the quality of the system, its services and its information, affect both its use and user satisfaction which, in turn, affect the perceived net benefits. Likewise, Meidani et al. (2012) theorised that the quality of the organisation affects the success of the EMR implementation and this success affects the quality of the hospital processes and services.

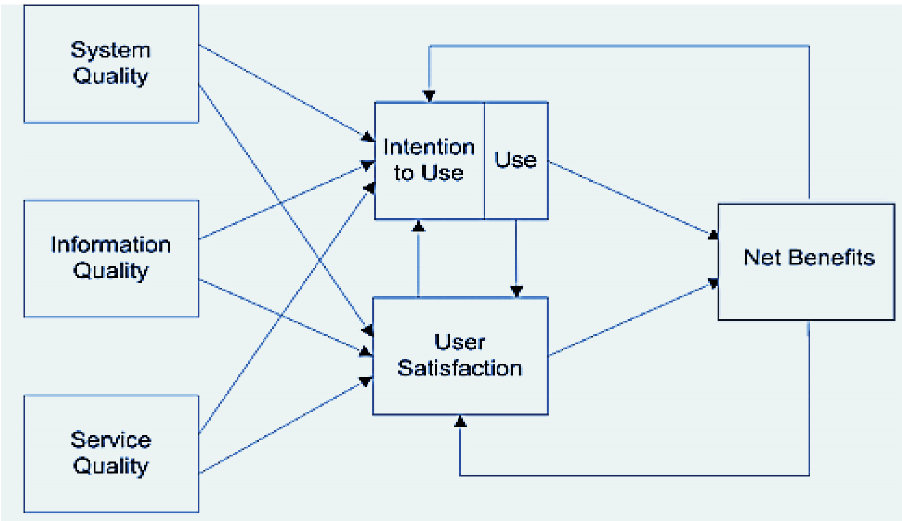


Figure 6: IS Business Success Model (Delone & Mclean (2003))

Although Information Systems Business Success Theory is useful to explain use behavior and the bilateral impact of perceived net benefits, as well as customer satisfaction and use, it does not say anything about the impact of these positive perceptions and top management's decisions regarding further EMR implementation. Thus, Badewi et al. (2013), as illustrated in Figure 7 , considered the attitudes of top management to a new information system, and how these attitudes affected both its use and users' resistance to change through the investment, in terms of time and effort, in learning, as well as other factors that might affect this resistance. Indeed, although this model interprets many important relationships in the diffusion of the use of information systems in organisations, it has not been applied to medical systems in general and to EMRs in particular.

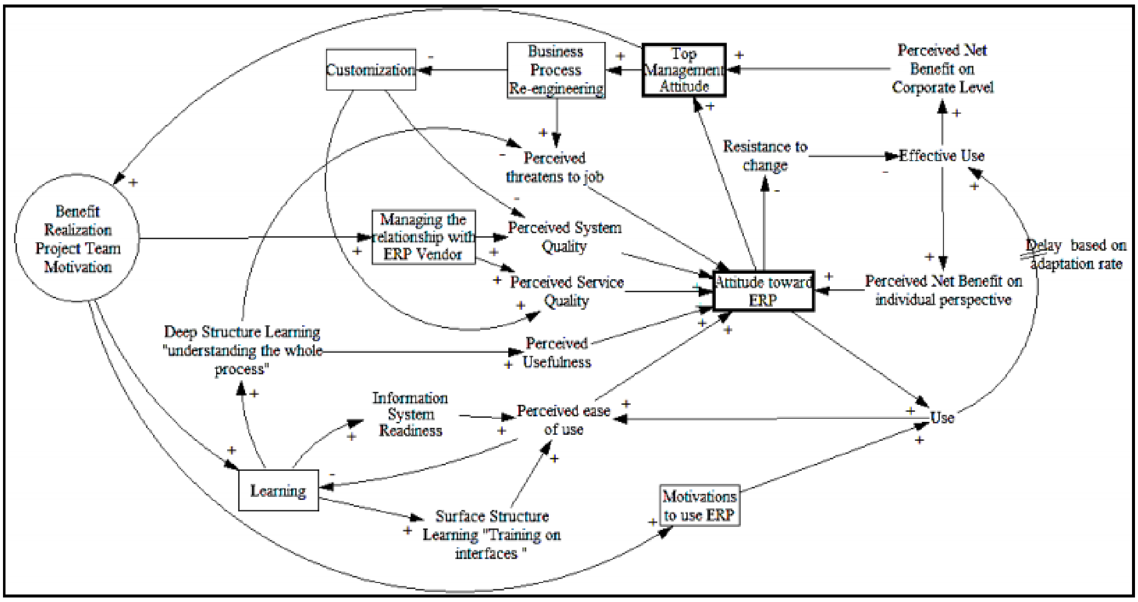


Figure 7: Benefits' relisation model using IS Business Theory (Badewi et al., 2013)

2.6 Critical Factors Influencing the Adoption of EMRs in Hospitals

Although the literature mentioned previously partly explains the spread of EMRs, the whole picture can be viewed if the literature on EMR critical success factors (CSFs) is investigated. After synthesising this literature, these factors have been classified into six main themes which are user, organisational, technological, financial, governmental and environmental factors.

2.6.1 Success Factor Matrix Model

This model was proposed by Ash (2003), as illustrated in Figure 8, who identified 12 different success factors to facilitate the process of computerised physician order entry (CPOE) implementation. These 12 principles were clustered into four groups represented by the mnemonic CPOE. These signify: Computer technology principles (temporal concerns, technology and meeting information needs, multidimensional integration, and costs); Personal principles (value to users and trade-offs, essential people, and training and support); Organisational principles (foundational underpinnings, collaborative project management, terms, concepts and connotations, and improvement through evaluation and learning); and Environmental issues (motivation and context for implementing such systems).

Figure 8: Critical success factors for EMR implementation (Ash, 2003)

2.6.2 User Factors

Users and their needs play a crucial role in the implementation of an EMR and these need to be assessed before introducing new technology (Townes, 2000). Without the proper use of the system, its value will be zero or even negative (Peppard, 2007). Besides the IS Business Success and TAM theories (Petter et al., 2008a; Venkatesh et al., 2012b) which focus on the attitudes and perceptions of users, there are other factors noted in the literature as critical success factors that affect users. For instance, when nurses believed in the benefits of an EMR in Interventional Radiology, this led to an effective and efficient transformation from a manual to a computerised system without sacrificing the quality of patient care (Horte and Visconti, 2014).

Readiness for and acceptance of a new intervention can be enhanced by identifying core values and understanding end-user needs and, more importantly, by demonstrating its benefits to all levels of staff: e.g., doctors, nurses and administrative staff (Kotter, 1995; Moreno, 2005). The importance of involving these multilevel staff has also been highlighted by many studies which reported that user resistance to change and low levels of acceptance by doctors and nurses are the main barriers to EMR implementation; chances of success can be improved by overcoming them (Jha et al., 2009; Gans et al., 2005; Mohd and Syed Mohamad, 2005).

Physicians, nurses and other staff have long been using PBMRs, and so using computers, interconnectivity and access to medical records via the web is a new and challenging notion (Smith and Newell, 2002), especially in developing countries like Saudi Arabia (Aldosari, 2014; Aldosari, 2012). For a successful implementation, it is important to maintain the flow of users' usual work despite the introduction of the new technology (Gans et al., 2005; Halley and Kambic, 1996). The fitting of new interventions into the clinical workflow can be ensured, however, with appropriate levels of staff training; otherwise, the implementation process may fail (Wager et al., 2001; Smith and Newell, 2002). Even after training, users will expect a good deal of help from the support team, especially in the initial phases of the implementation (Gans et al., 2005). If issues are not properly handled, it may result in disillusionment as well as disenchantment that will adversely affect the ongoing implementation process (Dick et al., 1997; Miller et al., 2005).

Similarly, the on-going training of staff is very helpful in maintaining their pace with the new technology and so management needs to ensure that the vendor provides this on a regular basis (Wager et al., 2001). For instance, EMR-certified physicians use the system more meaningfully than those who are not so certified (Peterson et al., 2014). In this regard, a strong partnership between the vendor and the organisation is necessary (Swanson et al., 1997). It is the vendor's responsibility to be flexible and available to make modifications to the system, fixing related problems whenever they are identified by physicians or any other staff; this is a key for the successful implementation of an EMR (Smith and Newell, 2002). A prompt response from the vendor to any identified problem will enable staff to keep the system running; otherwise, clinical staff may have to find other ways to record clinical data (Keshavjee et al., 2001). Similarly, continued feedback and dialogue between users, management and the vendor are important so management should provide such opportunities as this will improve the overall implementation process (Chin, 2004; Keshavjee et al., 2001). Furthermore, it is suggested that there should be regular scheduled meetings among EMR champions and users in order to maintain enthusiasm for the EMR implementation process (Hendy et al., 2005).

2.6.3 Organisational Factors

Organisational factors relate to the descriptive measures of organisations or hospitals, such as scope, size and structure, and general organisational issues facing the decision makers while adopting EMRs in hospitals (Khoumbati et al., 2006). According to Dansky (1999) and Wager (2001), top management facilitates and ensures an allocation of sufficient resources at every step of the implementation and even supports any redesigning if needed. It is difficult to face existing stresses without the real support of management (Jha et al., 2009; Townes Jr et al., 2000; Gans et al., 2005). In this regard, the role of the project manager, who needs to fill the gap between top management and key stakeholders with strong managerial skills, becomes more distinct (Packendorff, 1995; Sanchez et al., 2005). An organisational culture with poor communication and a lack of clinical leadership is therefore a serious barrier to the adoption of EMRs (McCullough, 2008).

Change management is also a crucial step for a successful EMR adoption since such adoption requires many levels of interaction among personnel, management and the system. There should also be an assessment of the readiness for major organisational change in the hospital in terms of training, leadership, commitment, individual engagement and trust, culture, politics, bureaucracy and professional ethics (Stablein et al., 2003; Doebbeling et al., 2006). In the same vein, those organisations that are able to adopt higher levels of service innovation are able to implement an EMR more successfully (Bhuyan et al., 2014). This is due to organisational readiness which refers to the ability of an organisation to adapt to the external environment. This readiness could be affected by the level of sophistication of its IT infrastructures; the availability of EMR professionals in the hospital (Khoumbati et al., 2006); usability issues, such as difficulty in migrating from paper to electronic formats and problems integrating the systems; and the lack of an easy way to input data and notes (McCullough, 2008).

It has been reported that a successful implementation of EMR will improve safety, care and outcomes for patients while offering faster access to health information. However, at the same time, it also increases the workload of physicians and other healthcare staff (Berner et al., 2006). In order to make an EMR implementation sustainable, top management needs to adjust the policies and procedure systems in the hospitals as it is worthwhile giving some incentives to users so that they may also benefit from the use of EMRs (Wang, 2003). Likewise, Pearson (2008) reported that pay-for-use and pay-for-performance programmes have a positive impact on EMR adoption processes.

In summary, as presented in Table 3, EMR the critical success factors discussed in the literature include cultural factors, top management support, compensation schemes and incentives, the use of project management, allocation of resources, and readiness for change.

Table 3: EMR critical success factors in the literature

Factor	Literature
Culture (e.g. leadership style)	(McCullough, 2008)
Top management support	(Jha et al., 2009; Townes Jr et al., 2000; Gans et al., 2005)
Compensation schemes incentive systems	(Bates et al., 2003; Pearson et al., 2008).
The use of Project Management	(Packendorff, 1995; Sanchez et al., 2005)
Allocation of resources for or against EMR	(Dansky et al., 1999; Wager et al., 2001)
Readiness for change	(Stablein et al., 2003; Doebbeling et al., 2006)

2.6.4 Technological Factors

After an organisation has decided to implement an EMR, choosing the right software is another critical step (Gleason and Farish-Hunt, 2014). According to Young (2000), software systems that are not user friendly make the implementation process more difficult while the availability of different systems offered by different vendors in the market make it difficult for management to decide upon which system to implement (Townes, 2000). As McDonald (1997) reported, the existing sources of patient information, such as laboratory and pharmacy reports, etc. in previously provided software, reside on various isolated islands; these are very difficult to link together. This inability to integrate different systems is perceived to have a negative effect on patient safety (Hendy et al., 2005). In order to increase the chance of success, a critical evaluation of software needs to be carried out in terms of its cost, friendliness, integrating capacity and vendor issues (Gans et al., 2005). Poon (2010) also emphasised that the focus and objective should be to increase the use of robust EMR systems rather than opt for a simple and quick adoption.

As well as the need for the IT department to be aided in selecting a suitable EMR vendor, the existence of technical assistance has been found to be helpful in enhancing the quality of patient care (Boas et al., 2014). Privacy and confidentiality is another important aspect of EMR implementation and its legal definitions change from time to time (Gans et al., 2005). EMRs provide data access to many healthcare staff at a time and so its trade-offs must be maintained with confidentiality (Rind, 1997). Generally, most patients think that such a system is safe but 20-40% of patients have more concerns and these need to be addressed (Hassol, 2004; Pennbridge, 1999). There is a strong need to minimise the risk of inappropriate data acquisition for the sake of the integrity of the EHR. This can be achieved through education concerning appropriate access and control, network security, and clear ownership of data (AHIMA, 2010a; Young, 2000; Barrows, 1996).

2.6.5 Financial Factors

Financial resources were one of the main barriers reported in the literature facing the adoption of EMRs in hospitals today (Jaana et al., 2012; McCullough, 2008). According to Jaana et al. (2012), prior research has found significant relationships between the level of EMR capabilities in hospitals and the financial capacity in those hospitals. The feeling of instability in securing financial support to implement the EMR influences the enthusiasm of the users and leads to frustration; this could lead the system to fail (Hendy et al., 2007).

Furthermore, small hospitals often simply cannot afford to introduce EMRs owing to their limited budgets. Although many countries have introduced some financial support and incentives to encourage small hospitals to adopt EMRs, these countries will remain at a disadvantage given their inability to afford the core requirements before the implementation, such as the IT infrastructure, professionals and training (Jaana et al., 2012); there is also an unclear return on investment in EMR adoption (Parente and Van Horn, 2006). Additionally, financial problems and economic downturns may affect the budget allocated to the EMR implementation, even in countries like the UK (Hendy et al., 2007).

2.6.6 Governmental Factors

Previous studies agree that a national strategic direction is the first step towards the development of EMRs in hospitals (Hammond, 2008) since well-deployed governance strategies can successfully address the issues associated with hospitals adopting EMRs (Blendon et al., 2004). In contrast, poor government support can constitute a significant barrier to the adoption of EMRs as the highest standard of governance is required to ensure that hospitals support change, and maintain the security and accuracy of their records (Parente and Van Horn, 2006). In addition, the government and private insurers have developed incentives to encourage the uptake of EMRs through policies and procedures such as prospective payments and capitation (Baker and Phibbs, 2000).

2.6.7 Environmental Factors

This category of factors refers to the environmental conditions in which the hospitals operate and are considered as important drivers in the adoption of medical information systems reported in the literature (Khoumbati et al., 2006). For example, market competition might influence the adoption of EMRs in hospitals (McCullough, 2008); interactions between hospitals may also play a role as hospitals learn from each other about the value of EMRs to the quality of medical services and patient satisfaction. Through the network externalities available to hospitals, medical staff will use other experiences to encourage the hospital management to adopt an EMR system. In fact, the stakeholders of the medical information systems in the hospitals are considered to be one of the main sources of pressure on management to adopt the most recent technologies (Khoumbati et al., 2006). Burke et al. (2007) and Berndt et al. (2003) also explain that network externalities among physicians within hospitals and neighbours' experiences of other hospitals hasten the adoption of medical information systems.

2.7 Research Framework

In summary of the literature review, the research framework is based on three underpinning theories, as illustrated in Figure 9. Perceptions of the benefits of EMRs over PBMS are a key driver in implementing an EMR; additionally, these perceptions of benefits, when they are mixed with the perception of ease of use and usefulness, lead to positive attitudes towards EMR systems (DeLone and McLean, 1992; Petter et al., 2008a; Venkatesh et al., 2012b; Badewi et al., 2013). It is argued that if positive attitudes towards such a system are combined with critical success factors of EMR implementation, the level of EMR adoption will be improved (Gans et al., 2005; Mohd and Syed Mohamad, 2005; Jha et al., 2009).

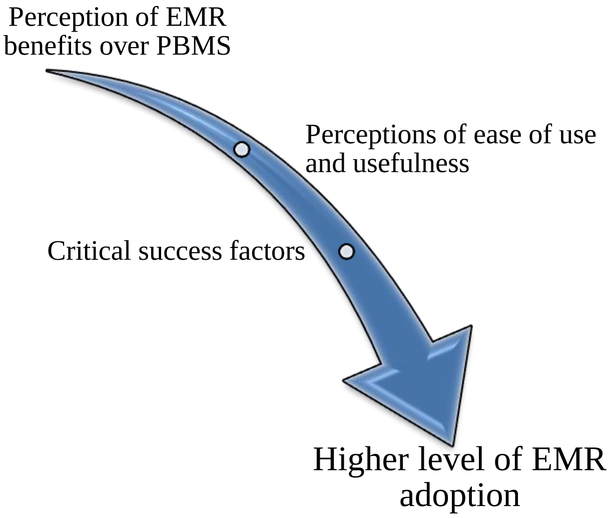


Figure 9: Research Framework

2.8 Conclusion

The literature does not provide a framework to help hospitals identify the factors that lead to further implementation of EMRs, therefore moving them from stage to stage. Furthermore, there is a lack of literature regarding the reasons and motivators for EMR diffusions, particularly concerning EMR critical success factors and the advantages of such systems over paper-based ones. Nevertheless, based on this insufficient existing literature, the research methodology in this study has been developed to use the previous theories as a focus for finding out what factors have lead hospitals to upgrade from stage to stage or to downgrade from stage to stage. In order to do this, it is necessary first of all to identify which hospitals upgraded and which ones downgraded. Therefore, the first research question is to explore what is the level of EMR implementation in the Eastern Province while the second question is to examine what factors determine the level of EMR implementation and what factors lead to upgrading or downgrading.

Chapter Three: Research Methodology

3.1 Introduction

The concept of EMR adoption in Saudi Arabia remains a new phenomenon. One of the main initiatives taken by the current Minister of Health is to enforce hospitals' accreditation (http://www.himssme.org/moh14/). Being accredited means that the hospital not only provides high quality medical services based on best practices, but also is internationally recognised as achieving international quality standards in health. As a result, the hospital must follow certain standards, including health data standards, in order to be accredited. Likewise, the implementation of EMR is a fundamental requirement to be accredited for the Joint Commission International.

Nevertheless, the literature examined in previous chapters reveals that hospitals in Saudi Arabia rarely adopt the EMR system (Bah et al., 2011). Therefore, it is necessary to find out which hospitals have adopted any stage of EMR, and why these hospitals have not fully adopted such a system. By doing so, the factors affecting the level of EMR adoption will be uncovered.

In addressing the gaps in knowledge, this study encompassed two research phases. Firstly, a pilot study in the eastern province of Saudi Arabia was carried out in order to evaluate the stage of EMR implementation in Saudi hospitals. Secondly, an in-depth analysis of three case study sites (at varying stages) was carried out to investigate their motivations and barriers to achieve their current stage of EMR implementation.

3.2 Research Philosophy

According to Remenyi (2005), every empirical study is based on the underlying concept of what constitutes knowledge. This is the epistemology of the work. Epistemology has been defined and described by different authors in different ways. For example, Crotty (1998) described epistemology as the method of knowing what we know while Cornford & Smithson (2006) defined it as the constitution of valid knowledge that is acquired only through the investigation of a phenomenon. Myers (1997) referred to epistemology as the assumptions about knowledge and the methods conducted to gain knowledge. Walliman(2006) described epistemology as the ways of knowing things, and what we can consider as acceptable knowledge in a discipline. Therefore, epistemology looks at examining knowledge in practical settings in order to develop new understandings because knowledge, and the ways of discovering it, is not static, but forever changing (Grix, 2002).

In contrast to the positivistic paradigm that focuses on testing hypotheses and generalisation, the constructivist paradigm does not consider the world to exist as an objective reality (Walsham, 2006; Kanellis and Papadopoulos, 2009) but rather focuses on the primacy of subjective consciousness (Walsham, 1995b). Each situation is distinctive; its meaning is a function of the circumstances and the individuals involved. Therefore, generalisation is not a core aim of interpretive research (Walsham, 1995a). The researcher's role is to look beyond the details of the situation to understand the reality behind them, and then construct a meaning in terms of the situation being studied. In addition, the constructivists' conception is that the world not only consists of multiple realities, but also, that each reality is an artefact in its own right (Remenyi, 2005).

Details the classification of research paradigms developed by Tashakkori & Teddlie (1998; 2002; 2008). They classified research paradigms into four world-views: Positivism, Post-positivism, Pragmatism and Constructivism. The positivist paradigm uses quantitative methods and deductive logic to test propositions (Singleton and Straits, 2005). Positivist researchers seek to achieve objectivity and believe in naïve reality, a unified single reality regardless of the context. However, modern positivists, called post-positivists, have further refined the position, and highlight that reality is different from context to context. For instance, what is right in the UK might not be right in Saudi Arabia. Therefore, post-positivists prefer to start their research qualitatively, to understand the context before developing propositions from literature (Creswell and Clark, 2007). The post-positive and positive paradigms use the same logic of testing propositions (or hypotheses) as an epistemology to gain knowledge, with a belief that objectivity can be achieved (Tashakkori and Teddlie, 2008). However, they differ in the nature of inquiry methods deployed in the research.

Table 4: Comparisons of four important paradigms used in the social and behavioural sciences

Paradigm	Positivism	Post-positivism	Pragmatism	Constructivism
Methods	Quantitative	Primarily Quantitative	Quantitative + Qualitative	Qualitative
Logic	Deductive	Primarily Deductive	Deductive + Inductive	Inductive
Epistemology	Objective point of view. Knower and known are dualism	Modified dualism. Findings probably objectively "true."	Both objective and subjective points of view	Subjective point of view. Knower and known are inseparable.
Axiology	Inquiry is value free	Inquiry involves values, but they may be controlled	Values play a large role in interpreting results	Inquiry is value bound.
Ontology	Naïve realism	Critical or transcendental realism	Accept external reality. Choose explanations that best produce desired outcomes.	Relativism

The third paradigm in the above table (Table 4), pragmatic research, uses the positivist and constructivism approaches either in parallel or sequentially (Venkatesh et al., 2012a). Since the aim of this research was to understand the factors which might influence the level of implementation of EMR in Saudi Arabia, an interpretive paradigm using a mixed method approach was appropriate to investigate and understand the complex processes operating. This way of combining both paradigms is explained by Creswell and Clark (2007) and Tashakkori and Creswell (2007) as a useful paradigm which draws on the benefits of both positivistic and constructivist approaches. It has been argued that the sequencing of paradigms, (e.g. starting with an interpretive approach and then incorporating positivist approaches) is better than parallelising them (Ridenour and Newman, 2008). This study therefore started with an initial quantitative survey phase prior to the mixed method case studies.

3.3 Study Design

Research methodology refers to a procedural framework's particular style and the particular research methods used to collect data from real practical settings for solving specific problems (Remenyi, 2005). Yin (2008) detailed factors that should be taken into consideration when selecting the most suitable research methodology. These factors are the research questions, the researcher's control over behavioural events, and the contextual factors. Orlikowski and Baroudi (1991) argued that although there are many research methodologies that can be used to study a social phenomenon in its practical setting, the selection of the most appropriate one is always dependent on the nature of the research topic and questions, and also the researcher's capabilities and experiences.

This research had two main phases of data collection, as illustrated in Figure 10, within a mixed method design. Firstly, an exploratory pilot study using quantitative survey methods was followed by a second phase of in-depth multiple case studies using quantitative and qualitative methods. The initial phase of the work was designed to provide detail of the current situation across a region, and to elicit information for the purposive selection of case studies in the second phase.

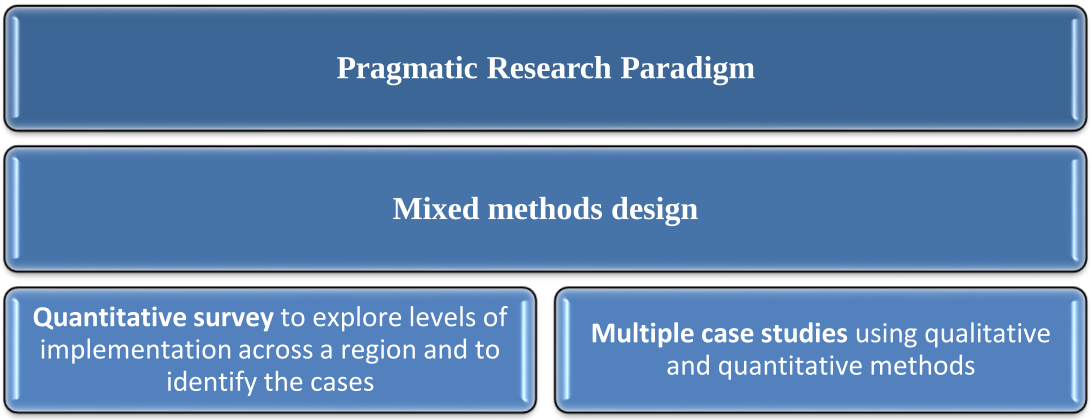


Figure 10: Research philosophy and design

The survey in the first phase aimed to gather information regarding stages of progress and stages of adoption of EMR systems in one province of Saudi Arabia. The second phase case studies aimed to explore staff views and experiences of implementing EMR. The following sections outline each phase as summarised in Figure 11.

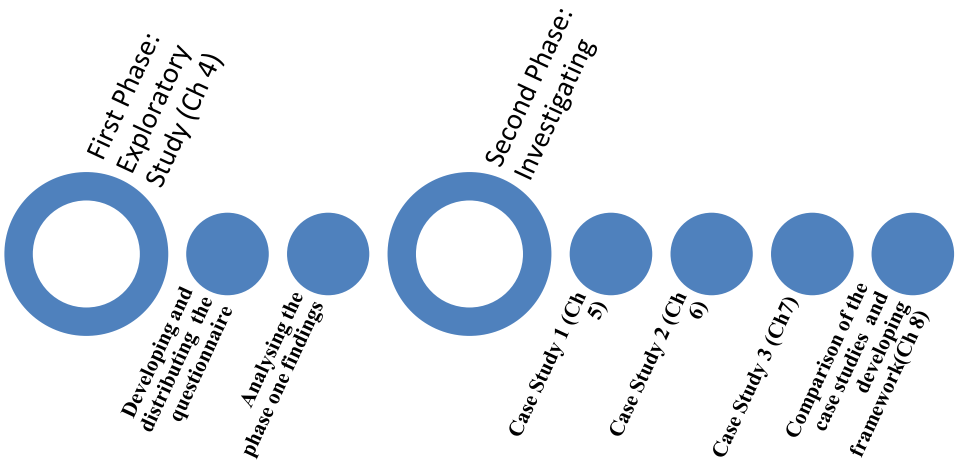


Figure 11: Study design

3.3.1 First Phase Survey

The aim of this methodological phase was to identify the current situation regarding the stages and adoption of the EMR system in Saudi MoH hospitals in one particular region. This first phase was designed to gather data on the situation across the region, but also to identify factors to select case studies purposively for the second phase of the work.

3.3.1.1 Methods used in the first phase

Questionnaires (also known as surveys) are an appropriate tool to collect quantitative data from a large-scale population. Questionnaires encompass a list of structured questions that are prepared in advance (Rugg and Petre, 2006). According to Walliman (2006), a questionnaire method enables the researcher to organise the questions and receive replies that allow rapid statistical analysis. McColl (2001) stated that a questionnaire instrument should be concise, simple and straightforward to avoid non-response through uncertainty. Although responses to questions could have been gathered via qualitative methods, such as interviews and focus groups, these were not considered feasible, as it would have been too time consuming to interview staff from all hospitals across a region.

The content of the questionnaire was developed based on the review of the literature, together with the researcher's experience and experts' feedback. The main source for the development of the questionnaire found within the literature was the HIMSS model. The HIMSS categorisation scheme was adapted from the classification approach developed by Garets and Davis (2005), which is thought to be the most appropriate available model to investigate the stages of the adoption of EMR systems in hospitals (Jaana et al., 2012). This model consists of EMR stages based on the implementation status of various interrelated medical systems and helps in examining the extent to which the EMR systems within hospitals are implemented. The system allows hospitals with different medical systems to be classified at a number of stages depending on the nature of these systems, their complexity and the degree of interface.

Once the first draft of the questionnaire was developed, the researcher examined its suitability and accuracy by piloting it amongst experts, such as the researcher's supervisors and IT experts in Saudi hospitals; the content was then adjusted based on their feedback and perceptions. Pre-testing was performed to improve the validity and reliability of the questionnaire. This was done by distributing questionnaires to five sample hospitals in order to look for any errors that might have been missed by the researcher. The length of the questionnaire and the time spent to complete it were particularly important since some of the intended participants were senior managers and therefore their time for completing the questionnaire was limited.

3.3.1.2 Phase one sample

The final version of the questionnaire was distributed to all hospitals affiliated to the MoH in the Eastern Province of Saudi Arabia. Others, such as private hospitals, and government public hospitals such as university hospitals and National Guard hospitals, were excluded in order to achieve consistency among respondents and discover the factors that affected public hospitals, especially in the context of their obligatory implementation of EMR. The medical services introduced by the MoH represent approximately 58% of the total medical services in Saudi Arabia, with the remaining remain portion shared between other governmental bodies (23%) and the private sector (19%) (Altuwaijri, 2008).

Additionally, the selection of hospitals and gaining access to private hospitals in Saudi Arabia needs additional ethical approval. By selecting only the hospitals affiliated to the MoH, the researcher required only one access permit from the MoH to carry out the fieldwork and data collection. In contrast, if the researcher had selected all hospitals in Saudi Arabia, the researcher would have needed an access permit from each private hospital and from other government hospitals, which would not have been possible given the limited time and budget of the study.

3.3.1.3 Questionnaire distribution process

A cover letter was attached to explain the nature and purpose of the research, and the hospitals' directors were asked to complete the survey or forward it to the appropriate person responsible for IT departments. The participants were asked to return the survey form by email within four weeks, as in the study by Miller et al. (2005). In hospitals with limited internet facilities, a postal questionnaire or fax was sent to hospital directors. In order to increase the overall response rate, reminders were sent to respective hospitals, as recommended by many experts (McColl et al., 2001). NHS ethics committees tend not to be in favour of more than one reminder (Relton et al., 2011). However, in this study, the reminder was sent twice, as after the first reminder the response rate was too low to provide sufficient data for the study.

The researcher emailed the survey to 29 hospital directors in eastern province MOH hospitals, and a response rate of 79% (or 23 responses) resulted. This figure is acceptable and comparable to other similar studies. Work in Canada by Jaana et al. (2012), for example, targeted Chief Executive Officers (CEOs) in their respective hospitals and had a similar response rate of 84%.

3.3.1.4 Ethical considerations

The ethical considerations taken into account during this research were associated with informed consent, assurance of confidentiality, and anonymity. Ethical approval for the work was gained from the School of Health and Related Research (ScHARR) at the University of Sheffield Ethics Committee. In addition, the researcher provided the ethics review committee of the Ministry of Health (MOH), Riyadh, Saudi Arabia, with the required documentation, letters and a brief description of the research proposal. This step was required in order to gain permission to carry out the study and to obtain support from the MoH in Saudi Arabia.

With regard to ensuring the confidentiality and anonymity of participants, the researcher ensured that all the participants in this research, before agreeing to take part, were given a sufficient description of the study and its aims via a participant information sheet. The participants were assured that the data they gave would be processed by only the research group in a highly confidential manner. It was important to ensure that participants' identities would remain anonymous throughout the study. During the qualitative data collection, the researcher ensured that participants gave informed consent before using a tape recorder.

3.3.2 Second Phase: Multiple Case Studies

A case study method was selected for data collection during the second phase of the work for several reasons. Firstly, such a method enables the researcher to understand the context of the subject under study and, secondly, it enables the researcher to answer the research question "Why" (Yin, 2008). Additionally, mixing quantitative and qualitative methods to study a specific phenomenon is best used in case study research (Kaplan and Duchon, 1988a). The quantitative method (i.e. questionnaire) helps to explore a phenomenon across a large number of users in one case which is complemented by qualitative methods (interviews, focus groups and document analysis); this enables research to explore in-depth and gain further understanding of data gathered via questionnaires.

3.3.2.1 Case study selection process

The first phase survey enabled the researcher to identify the hospitals for the second phase of the study. In the second phase of this study, the researcher aimed to select three hospitals, each at a different level of EMR implementation to answer 'how?' and 'why?' questions, and therefore to identify the critical factors influencing the adoption of EMR systems in Saudi MoH hospitals.

Three hospitals were selected based on data from the questionnaires relating to the HIMSS analytic model. Case studies at levels one and two were selected as there were no hospitals which had achieved level 3. In order to achieve diversity, two level 1 hospitals and one level 3 hospitals were selected, as illustrated in Table 5. The selection also took into account the hierarchical level of the hospital to ensure representation of tertiary, specialist and general hospitals.

Table 5: Hospitals and their stages according to the HIMSS model in terms of EMR adoption

	HIMSS Stages*							
	0	1	2	3	4	5	6	7
Hospital-1		X						
Hospital-2		X						
Hospital-3				X				

*based on the results of the exploratory study

3.3.2.2 Data collection methods

Different data collection methods were used in this research, as illustrated in Figure 12, to collect the empirical evidence. These methods included a questionnaire, semi-structured interviews, focus groups and analysis of documents. In the following sections, each method is explained; thereafter, the benefit of triangulating these methods is explained.

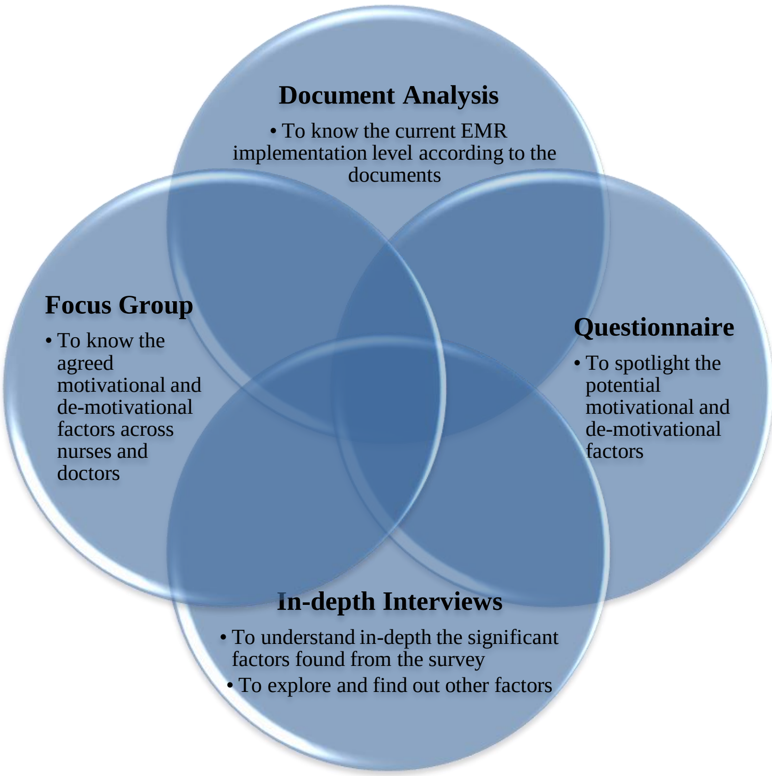


Figure 12: Data collection method

3.3.2.2.1 Document analysis

One of the qualitative tools that can aid in understanding the problem in-depth is documentation (Anderson, 2010). Documentation was used to corroborate and augment evidence from other sources and to provide some general information with regard to the studied cases. Documentation analysis was carried out using many forms, such as IT service providers' reports and documents, implementation documents, letters, reports of events, administrative records, newspapers, websites, etc. In this respect, participants were asked for any documents that were thought to be related to the adoption process of EMR systems in Saudi MoH hospitals, as long as they were not confidential (Anderson, 2010).

3.3.2.2.2 Questionnaire

Study questionnaires were distributed to users including doctors, nurses, and radiology, laboratory, pharmacy and archive staff in each of the three MoH hospitals in the Eastern Province of the country. This questionnaire was a further refined version of the tool that was used in the first phase of the study, and had been modified in response to the feedback received during the previous phase as illustrated in Figure 13 , and to ensure that the tool met the requirements of this phase of the work.

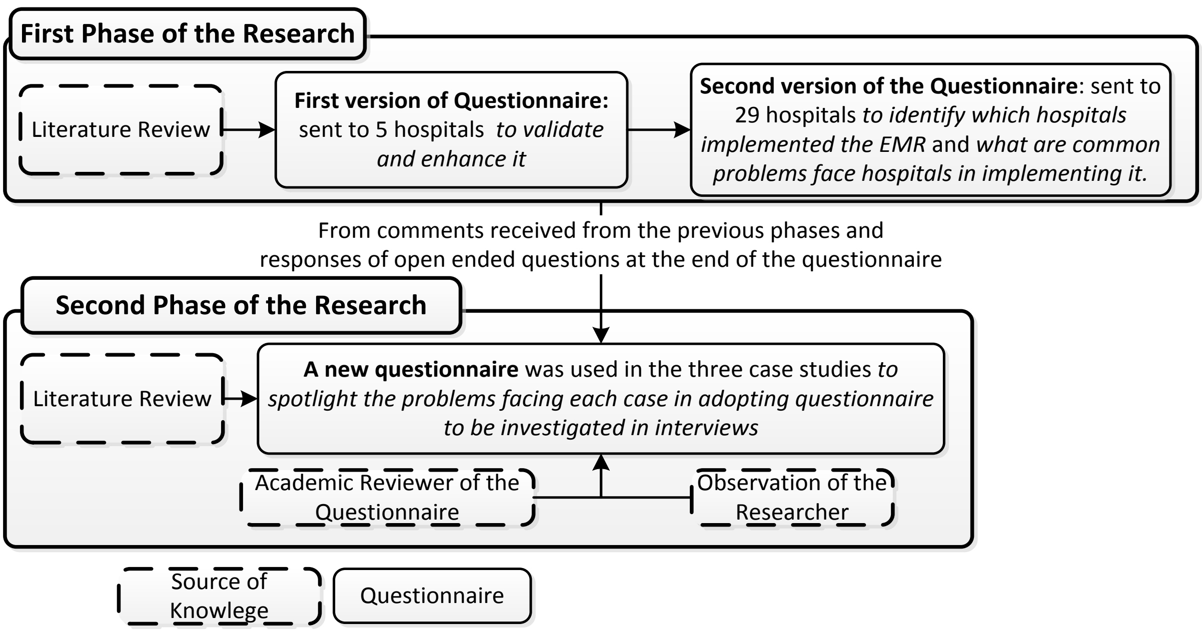


Figure 13: Questionnaire development in phase 1 and phase 2

As the aim of this questionnaire was to highlight the potential motivational and de-motivational factors affecting the hospitals' progress in EMR implementation, the data were intended to be used for descriptive and inferential purposes (Field, 2013). Based on Tshebshiev's theory, a random sample size of 30 or more participants was needed in order to carry out meaningful statistical analysis (Punch, 2013). Therefore, the second phase of the study aimed to achieve a sample of between 79 and 100 respondents in each case study site.

3.3.2.2.3 Semi-structured interview

For the semi-structured interviews, the researcher prepared an agenda of the interview in advance, including the number of questions. This acted as a guide, although an interviewer may not necessarily follow this guide rigorously. By using a semi-structured interview method, a researcher can ensure that the same topics are covered in each interview while it still allows emphasis to be shifted as appropriate (Cornford and Smithson, 2006).

The sampling of staff for the interviews was purposeful as the aim was to study a range of decision makers' perspectives. The sampling process in quantitative studies is different as the aim of them is to generalise and therefore a sample needs to represent the population; in qualitative research, on the other hand, there is no aim for generalisability (Anderson, 2010). Prior to the interview participants signed a consent form and interviews lasted approximately 30-45 minutes.

The interviews were tape-recorded. Recording the interview is believed to increase the accuracy of the data and to prevent data being lost during transcription. The information provided by participants was kept in locked cupboards under the custody of the investigator and no one else had access to the data. The recorded information was kept anonymously for transcription purposes. After transcription, the data were analysed anonymously by attaching a unique ID to each interviewee's information. Anonymity was maintained during report/paper writing, presentation and publication.

3.3.2.2.4 Focus group discussion (FGD)

A Focus Group Discussion is a form of qualitative inquiry and focus groups are uniquely suited to helping members of specific groups (e.g. nurses or doctors) articulate their beliefs, values, desires, concerns, aspirations and needs in ways that produce a finer, richer aggregate, with greater community representation than is often achieved via other common assessments of group perceptions, needs and knowledge (Huston and Hobson, 2008). Since qualitative inquiry cares about validity more than the reliability (Maxwell, 1992), focus groups outperform traditional interviews in terms of the validity of the results by assessing the degree of acceptance toward statements issued by one or some of them across focus group members (Jayasekara, 2012). Nevertheless, focus group discussions have drawbacks, such as the inability of some of members to talk freely while some members are more talkative than others (Halcomb et al., 2007).

Although the survey is a favoured tool for examining the perceptions of a relatively larger number of individuals than a focus group can do, the focus group provides a reasonable adjunctive research tool that deserves careful consideration, mainly among researchers examining questions located within the matrix of health care needs and delivery (Huston and Hobson, 2008; Jayasekara, 2012). Along with decision makers, it was necessary to explore the views of other hospital staff that are actively using electronic medical records. These included physicians and nursing staff of the hospitals. The researcher conducted two FGDs in each hospital: one for doctors and the other for nursing staff, as nursing staff may not participate actively in the presence of doctors or consultants due to differences in hierarchical status.

3.3.2.2.5 Triangulation of methods

Maxwell (2004a; 2012; 2004b) described triangulation as the collection of empirical data by a variety of methods from a range of different individuals and settings. Yin (2008) outlined four types used to triangulate the results reported in a study: data triangulation, investigator triangulation, theory triangulation and methodological triangulation. Within this research, two approaches were used to triangulate the results: data triangulation and methodological triangulation. With regard to data triangulation, Remenyi (2005) detailed several ways to achieve this type of triangulation, such as the use of multiple data collection methods, multiple informants and cases. From one side, when qualitative data are analysed and presented in a meaningful way, it can help in examining the research issue in depth and may obtain more powerful information than the quantitative methods (Anderson, 2010). However, the lack of objectivity may be an issue in understanding the reality (Creswell and Clark, 2007). Therefore, quantitative analysis can actually decrease a researcher's subjectivity in interpreting the reality (Tashakkori and Teddlie, 2008).

3.4 Translation and Transcription Issues

Qualitative data were captured in Arabic as this is the native language of the researcher and the respondents. The transcription process began after the fieldwork was completed in Arabic and the data were then translated into English by an independent translator who speaks both languages (Arabic and English). In order to validate the translation, the researcher (who also speaks both Arabic and English) translated the English transcript into Arabic, and then compared the original transcripts and the translated version to assure that the translation reflected the transcripts.

3.5 Data Analysis

The quantitative data were entered by two different data entry operators to ensure accuracy. A similar approach was also taken in a hospital survey carried out by Jaana et al. (2012). An error list was generated to check errors. The data were then transferred into Statistical Software for Social Sciences (SPSS) for analysis. As illustrated in Table 6, different methods were used to analyse the quantitative data. In addition to analysing each form of data separately, the analysis aimed to deepen the understanding of the findings by comparing and contrasting them, by triangulating the sources, as a way of enhancing the validity and reliability of the research (Anderson, 2010).

Table 6:Data analysis methods

Phase one survey	**Mixed method case studies**	
Quantitative Analysis	Quantitative Analysis	Qualitative Analysis
***Descriptive analysis* using mean and standard deviation to describe the cases**	***Descriptive and inferential analysis*** *to understand and explain relationships amongst the data*	***Thematic analysis*** to find out the themes and sub-themes that appeared in the qualitative data from interviews and focus group
	Triangulation: methodological triangulation and data triangulation offer the researcher a holistic view of the case, allowing him/her to understand points of weakness and strength in the cases through quantitative data and in-depth investigation.	

3.5.1 First Phase Data Analysis Methods

In the statistical analysis, for the first and second phases, mean and standard deviations were reported for continuous variables (e.g., age, working experience of the respondent) whereas percentages were reported for categorical variables (e.g. gender, position, level of education of the respondent, etc. (Field, 2013). Using HIMSS guidelines, each hospital was checked against a set of criteria and evaluated for specific stages of EMRAM. The proportion/percentage of hospitals was reported in terms of their current stage on the HIMSS model: e.g., the number of hospitals at stage 1, stage 2, stage 3 and so on. The characteristics of the hospitals were also represented in both graphical and tabular forms on the basis of different parameters: e.g., geographical location, numbers of hospitals, level of facilities provided, primary/secondary/tertiary healthcare services.

3.5.2 Second Phase Data Analysis Methods

In the case study phase, i.e. the second phase, the questionnaire was used to identify the most commonly perceived hindrances and motivators to the implementation of EMR. Methodological triangulation was used to combine the results from this phase with the qualitative methods. The analysis of the quantitative data from the questionnaire was compared and contrasted to the analysis of the qualitative data in order to give a holistic view, as well as giving a more in-depth analysis of the background to the quantitative data.

3.5.2.1 Qualitative analysis

The analysis of the qualitative data was carried out using a thematic approach. The analytic framework was based on three things, as illustrated in Figure 9. As described previously in the literature review, the perception of EMR benefits over PBMS is a key driver to implementing an EMR. Additionally, these perceptions of benefits, when they are mixed with the perception of ease of use and usefulness, lead to positive attitudes towards the EMR system (DeLone and McLean, 1992; Petter et al., 2008a; Venkatesh et al., 2012b; Badewi et al., 2013). Indeed, if the positive attitudes towards the system combine with critical success factors, the level of EMR adoption will be improved (Gans et al., 2005; Mohd and Syed Mohamad, 2005; Jha et al., 2009).

This research adopted the six-step guideline of Braun and Clarke (2006) for analysing the qualitative data using a thematic analysis approach. The six-step guideline involves:

1- *Familiarising oneself with the collected data*: the researcher needs to immerse him/herself in the data in different ways, such as transcribing the data into a document, reading and re-reading the data, and noting down initial concepts.

2- *Generating initial codes*: the researcher generates as many potential codes as possible during this stage. The result should be a long list of different codes.

3- *Searching for themes*: the codes then need to be re-focused at a broader level by sorting and collating the generated and relevant codes into potential themes.

4- *Reviewing themes*: the researcher needs to refine the themes and their codes again, and examine each theme and its initial codes if they appear to form a coherent pattern. Sometimes, there is a need to develop new themes and rearrange the codes into new ones.

5- *Defining and naming themes*: once the themes have been fully reviewed, each theme must be redefined and named to reflect what aspects of the data each theme has captured. Each theme has its own story that must be fitted into the broader overall story of the results of the research.

6- *Producing the report*: once the scope for each theme is precisely described, in order to assure the validity of the analysis, the researcher starts reporting the complex story in a way that is easy for readers. The report should be also supported by sufficient evidence and quotations to enhance the reliability and validity of the themes.

3.5.1.2 Quantitative analysis

Quantitative analysis was carried out twice. The first time it was not only used to describe each case but also to be "another eye" in understanding it (Field, 2013). Therefore, descriptive statistics, such as mean, mode, average and standard deviation, were used since the qualitative analysis "looks at X in terms of how X varies in different circumstances rather than how big is X or how many X are there" (Anderson, 2010). Therefore, the use of quantitative analysis in the second phase was more rigorous than the one used in the first phase and focuses on inferential and differential analysis such as ANOVA, multiple regression and non-parametric mean comparison tests (Punch, 2013; Field, 2013).

On the one hand, non-parametric mean comparison tests were used to measure the significant differences between cases while, on the other, multiple regression and ANOVA were used to test the relationship between concepts that emerge from the cross-sectional qualitative analysis (Punch, 2013).

Chapter Four: Results of Phase One

Effective management of information within hospitals is crucial for efficient services and the adoption of a robust information technology (IT) infrastructure is seen as one of the key solutions to support/maintain health care quality (Al-Yaseen et al., 2010). Indeed, the adoption of multifunctional IT systems in healthcare sectors can yield real benefits in terms of improved delivery of care based on guidelines, enhanced monitoring and surveillance activities, a reduction in medication errors, and decreased rates of potentially redundant or inappropriate care (Chaudhry et al., 2006). In Saudi Arabia, up to 80% of the healthcare services are provided by the Ministry of Health (MoH) and other government bodies (Altuwaijri, 2008) . This phase of the research aims to understand the level of EMR implementation in the Eastern Saudi Arabian hospitals and the general perception towards its implementation. Based on this understanding, three hospitals were selected for investigation and in depth study in order to obtain further understanding of the factors affecting the adoption process.

This phase of the research consisted of two sub-phases: the first sub-phase involved developing the questionnaire and distributing it, as illustrated in Figure 14. The “Developing the questionnaire” sub-phase was aimed to test its validity as well as to assess any potential problems in the data collection process. This provided useful information on planning and conducting the main research study. The questionnaire in this phase was distributed to five hospitals; the feedback received was used to refine the questionnaire. Consequently, the second sub-phase was to distribute the questionnaire to all 29 hospitals in the Eastern province.

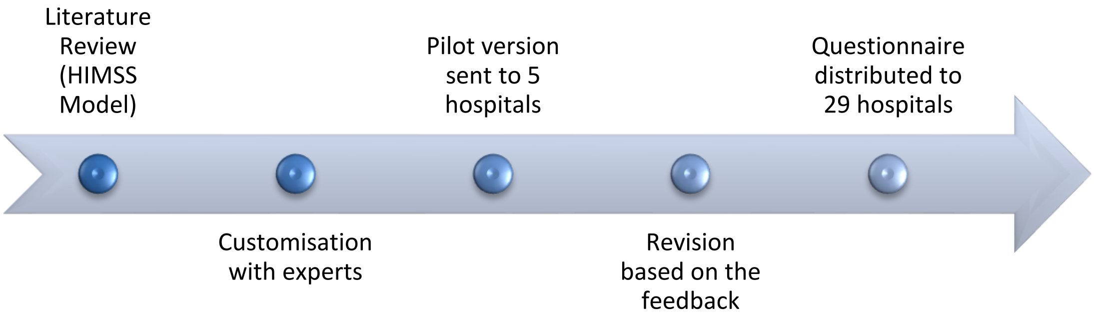


Figure 14: Questionnaire development process in the first phase of the research (exploratory research phase)

4.1 Pilot Study

4.1.1 Developing the Questionnaire Methodology

The preliminary questionnaire was developed from the literature, as well as from the knowledge and experience of the researcher. The Health Information Management System Society (HIMSS) model was the main source from which the questionnaire's structure was based. The categorisation scheme was adapted from the classification approach developed by Garets and Davis (2012) since this is thought to be the most appropriate model available to investigate stages in the adoption of EMR systems in hospitals (Jaana et al., 2012).

The questions were designed using clear, specific and unambiguous words to ensure that the questions would be understood in the same way by all participants and so that they were able to complete the questionnaire without help from the researcher. To ensure the reliability of the questionnaire, the researcher carefully read through the questions to ensure that there were no defects and that the responses given by any one respondent were not contradictory. In addition, and to ensure greater reliability, the researcher when distributing the questionnaire gave the participants several days to answer.

Five hospitals were selected for the pilot test of the questionnaire using convenient snowball sampling techniques and the researcher's personal experience and knowledge of the Saudi hospitals. Other reasons included the ease with which the hospitals could be contacted and the data collected from them. The hospitals selected in the questionnaire development sub-phase were only used for this development; they were not used later in evaluating the level of EMR implementation in the Eastern Province hospitals. Therefore, the hospitals in this development phase were not from the Eastern Province. The goal of the pilot test was to refine the questions so that respondents from different professional and educational backgrounds would not have any problem in answering the questions in both Arabic and English.

Table 7 presents key information about the hospitals selected in this sub-phase. Moreover, Figure 15 illustrates the characteristics of the selected hospitals which show variations in bed capacity and IT type. This diversity contributed to the success of the pilot test by providing a greater variety of perspectives. Agreement on a problem in understanding the questionnaire indicated an issue with the wording of the questions.

Additionally, consistency in the results might well indicate that, regardless of the size of the hospitals, there were other factors that affected the adoption of EMR. This study aimed to uncover these factors.

Table 7: Names and key information about the hospitals selected for the questionnaire development sub-phase study

Hosp No.	Bed capacity	Employees	Type of hospital	Establishing year	Type of IT system	Operation of IT system	Year IT system started	IT staff
1	1400	More than 5000	self operated	1980-1990	company operated	outsourced	1990-2000	200
2	50-100	400-600	self operated	1980-1990	company operated	outsourced	2005-2010	< 5
3	100-120	600-800	company operated	2005-2010	company operated	outsourced	2005-2010	< 5
4	250-400	1100-1400	self operated	1970-1980	self operated	in house	2000-2005	< 10
5	200-300	1800-2200	self operated	1980-1990	self operated	outsourced	2005-2010	< 5

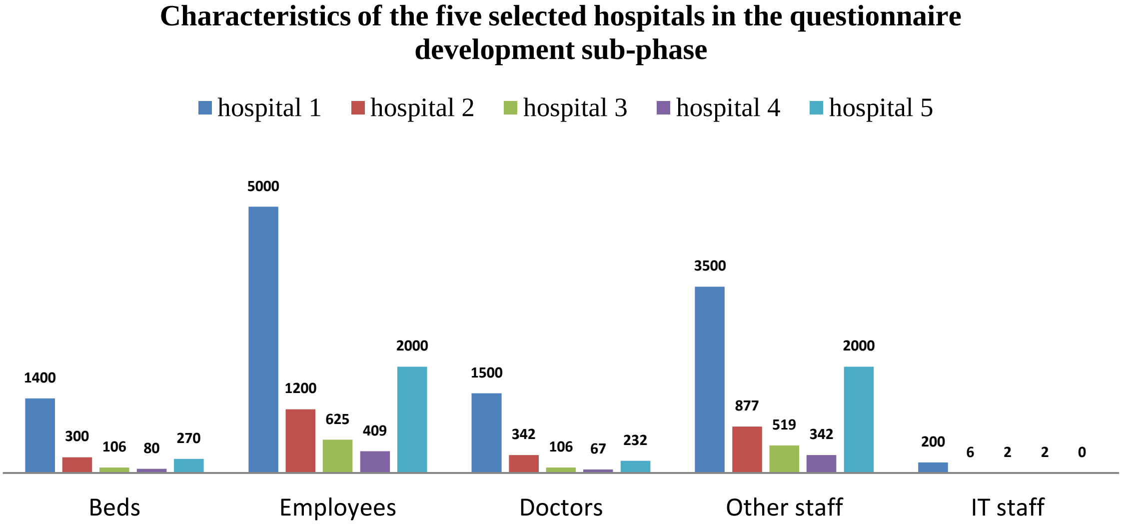


Figure 15: Characteristics of the five selected hospitals in the questionnaire development sub-phase

4.1.2 Results of the Pilot Study

4.1.2.1 Participants' responses

During the first wave of the data collection, three out of the five hospitals responded to the researcher. Two of the hospitals returned the completed questionnaire while one of the hospitals requested a translation of the questionnaire into Arabic. A successful response was achieved when the questionnaire was translated into Arabic and sent back to the hospital.

The second wave attempted to retrieve the data from the remaining two hospitals. The total time consumed in collecting data from all five hospitals was 33 days, measured from first contact with the first hospital until all the data had been collected from the last hospital.

The response rate was 100% and there were no missing data in the questionnaires; this confirmed that the study's questionnaire was easily comprehensible to the respondents. The notes recorded by respondents regarding the words and sequence of questions were taken into consideration and used to refine the questionnaire for the next sub-phase. Based on this experience, it was clear that an intensive approach would be required to increase the response rate in the following sub-phase which involved surveying 29 hospitals in the eastern province.

The mean age of the respondent was 46 years with a standard deviation of 8.3 years. The minimum age of the respondent was 33 years, while the maximum was 55 years; all of the respondents were male. On average, respondents had 13 years of experience with a median of 11 years. There was a variation in number of beds in the hospitals ranging from 80 to 1400 beds.

4.1.2.2 The level of EMR in the pilot study hospitals

Table 8 outlines the status of EMR in the selected hospitals. The departments or areas which had a fully installed EMR system were: pharmacy (n=3), bar coding (n=3), radiology (n=2) and one laboratory, emergency department, electronic medication, clinical decision support, and intensive care unit, each being at one hospital with full implementation.

Most of the hospitals were in the process of installing an integrated dictation system. However, one of the hospitals had no plan to install such a system in the future. The EMR system was either partially installed or was planned to be installed in the selected hospitals for a clinical data repository (CDR), clinical documentation, nursing notes, disease registry, ambulatory practice, and a remote patient system.

Table 8: Status of electronic health records (EMR) existing in the selected five hospitals of KSA in the questionnaire development sub-phase

Characteristics	Fully installed	Partially installed	Planned but not yet installed	No plan to install
	N	N	N	N
Pharmacy	3	2	0	0
Bar coding	3	1	1	0
Radiology	2	2	1	0
Laboratory	1	3	1	0
Electronic medication	1	2	2	0
Emergency department	1	2	2	0
Intensive Care Unit*	1	1	2	0
Computerised	1	1	3	0
Clinical decision	1	1	3	0
Disease registry	0	4	1	0
Clinical data	0	3	2	0
Nursing notes	0	3	2	0
Clinical documentation	0	2	3	0
Integrated dictation	0	2	2	1
Remote patient	0	1	4	0
Ambulatory practice*	0	1	3	0

* indicates variable with missing value

4.1.2.3 Perceptions of EMR

Table 9 shows the process of adoption in the studied hospitals. Most of the respondents agreed or strongly agreed that the EMR system was easy to use, while one person remained neutral on this question. Regardless of the size of the hospitals in terms of beds, only one hospital agreed that the EMR system was meeting their needs whereas the other four hospitals disagreed. This places a question mark over this phenomenon. Nevertheless, most of the respondents agreed or strongly agreed that the EMR system brought quality to patients' care and business enhancement.

Remarkably, most of the respondents agreed that organisational support was present for the introduction of the EMR system (for example, technical support, managerial support, training, awareness campaigns, or incentives to use). This might indicate that the resistance to change attitude had triggered the paradox of respondents not believing EMR to be important but, at the same time, perceiving it to enhance the quality of patient care. Furthermore, top management was working hard to push the implementation of the system even though there was implicit resistance in terms of not perceiving it useful. This was reflected in the intention to implement the system or planning to do so, as illustrated earlier in Table 8.

Table 9: The EMR system adoption process in selected hospitals of KSA in the questionnaire development sub-phase

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
There have been benefits in terms of quality of care, patient safety and business enhancement as a result of using EMR	3	1	1	0	0
EMR systems are easy to use	2	2	1	0	0
There has been organisational support for the EMR	0	4	1	0	0
The EMR systems used are compatible with hospital procedures, standards and policies	0	2	2	1	0
The EMR used in the hospital meets my needs	0	1	0	4	0

4.2 Phase One Study

4.2.1 Methodology of the Questionnaire Distribution

The questionnaire was distributed in the Eastern Province which is the biggest province of KSA with an area of 259,662 square miles. The total population of the Eastern province is over 4 million. Being one of the main industrial areas of the Kingdom and a main oil production province, it makes the largest contribution to the economy of the KSA.

The questionnaire was distributed to the whole population of 29 hospitals with the aim of receiving feedback from all of the MoH hospitals in the Eastern Province. However, only 23 hospitals responded. To cover hospitals at varying stages of EMR, this sub-phase of the questionnaire distribution included all hospitals affiliated with the MoH in the Eastern Province in Saudi Arabia. Private hospitals and government public hospitals, such as university hospitals and National Guard hospitals, were excluded, as explained previously in the research methodology chapter.

It is worth noting that the questionnaire's distribution had the full approval of the ethics committee and an access permit had been granted by the MoH-KSA to conduct the survey in the selected hospitals of the Eastern Province. Moreover, during the data collection process the researcher adopted multiple techniques to raise the response rate from the selected participants. The survey methodology adopted in this questionnaire development sub-phase was as follows: the researcher emailed the survey instrument to all the selected hospital directors so they would be aware of what was happening in the hospital. A cover letter was attached to explain the nature and purpose of the research, and the directors were asked to complete the survey or forward it to an appropriate person responsible for IT departments. The participants were asked to return the survey by email. In order to increase the response rate, the researcher followed up the study participants after four weeks. As the response rate was relatively high (79%), this could be an indication of the appropriateness of the corrections made to the questionnaire based on the responses in the questionnaire development sub-phase. To analyse the data, simple descriptive statistical procedures were used. For numerical data, means with standard deviation or medians, where appropriate, were presented. For categorical data, frequencies and percentages were used to describe the participants' attitudes and perceptions.

Finally, to discover the relationships between the factors that could affect EMR implementation based on the literature (Bossen et al., 2013; Petter et al., 2008a), EMR implementation was tested using regression analysis (Field, 2013). The stage of EMR was also analysed and reported based on the modified HIMSS scale. All the data entries and analyses were performed using SPSS software version 19.

4.2.2 Results of the Phase One Study

4.2.2.1 Participants' responses

The EMR system in KSA as a whole is at varying levels of implementation so there is a need to assess in depth the factors that affect the adoption process of EMR in the Eastern Province of KSA. The minimum number of employees in the sample was 136 and the maximum was 3000 with a median of 313 employees. Doctors accounted for 22% of the total number of employees in the selected hospitals and the non-doctor to doctor ratio among staff was 4:1.

The medical directors in the sample had a minimum of 2 years' and a maximum of 31 years' experience in the field; the mean experience was 8 years while the median experience was 7 years. Most of the hospital were self-operated (86%) and had a self-operating IT system (64%) while half of the hospitals had developed their IT system as an in-house effort and only 36% outsourced the IT system. About a quarter of the hospitals (23%) did not have IT staff in the hospital.

4.2.2.2 The level of EMR in the Eastern Province

The status of the EMR system is illustrated in Figure 16 and is detailed in Table 10.None of the hospitals had fully implemented EMR functionality. Two hospitals met the criteria of level one, only one achieved level three, and the remaining 20 hospitals were at level zero.

Based on the analysis of the 23 hospitals in, three hospitals were selected to be investigated and studied in greater depth since numbers 1, 5 and 18 had so far achieved a greater level of implementation than their peers. Therefore, it was necessary to understand their experience when adopting the system and also to understand why they had not progressed further.

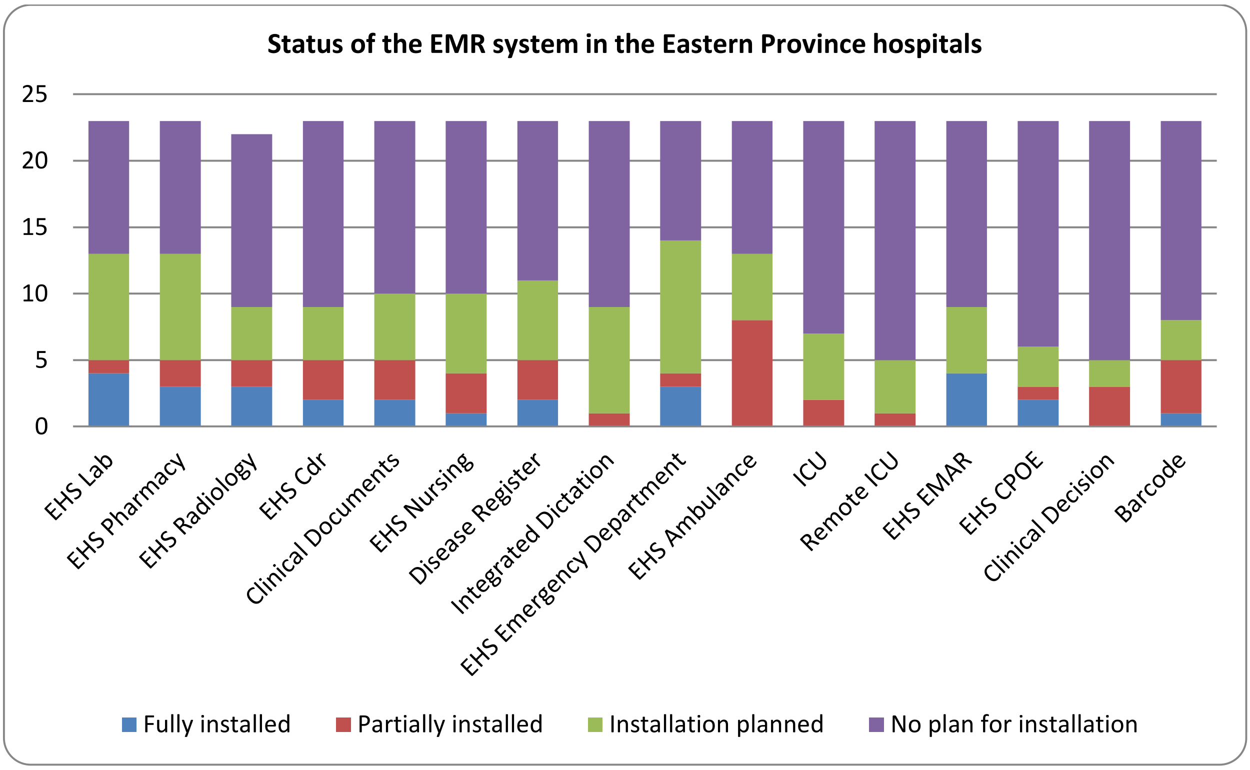


Figure 16: Status of the EMR system in the Eastern Province hospitals

Table 10: Key characteristics of MoH hospitals in the Eastern Province of the Kingdom of Saudi Arabia

ID No	Laboratory	Pharmacy	Radiology	CDR	CD	Nursing Notes	Disease Registry	Integrated Dictation System	Emergency Dep. System	Amb. Practice System	Intensive Care system	ICU	eMAR	CPOE	Bar Code
1	**Implemented**					**Partially Installed**		**Planned to install**	**Implemented**	**Partially**		**Planned**	**Implemented**		**Partially**
2	Partially							Planned to install		Partially		Planned	Implemented		Partially
3	Plan to install									Partially		Planned	Not planned		
4	Plan to install									Partially	Plan to install				
5	**Implemented**			**Partially**		**Planned**	**Partially**	**Planned**	**Implement**	**Planned**					**Partially**
6	Planned		Not planned	Planned						Partially	Not planned		Planned	Not planned	Planned
7	Planned				Not planned		Implemented	Not planned	Planned		Not planned				Planned
8	Not planned														
9	Planned		Not planned						Partially		Not planned				
10	Planned			Not planned						Partially	Not planned				
11	Not planned														
12	Not planned														
13	Planned		Not planned						Planned		Not planned				
14	Not planned														
15	Not planned								Planned	Not planned					
16	Planned														
17	Not planned														
18	**Implemented**							**Planed**	**Implemented**	**Partially**		**Implemented**	**Partially**		
19	Not planned														
20	Implemented	Partially		Planned						Partially	Not planned		Planned	Not planned	Partially
21	Planned									Partially	Planned				
22	Planned														
23	Not planned								Planned		Not planned				
24	Not planned														

** N/A= not available, the list of hospitals sorted from the year of opening of the hospital

4.2.2.2.1 Perception of ease of use

As explained in Table 8, there were only three hospitals with implemented EMR. However, there was a positive attitude toward EMR implementation among respondents. As illustrated in Figure 17, more than 60% of the respondents believed that the system was easy to use. Furthermore, no organisation strongly agreed that EMR was difficult to use while less than 10% agreed that it was difficult to use. This could be a signal that the perception of ease of use is not a critical factor affecting the level of EMR implementation.

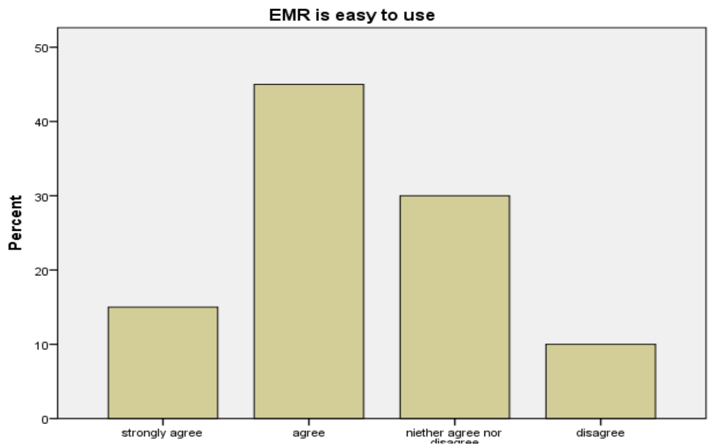


Figure 17: EMR is easy to use

Therefore, discovering the level of significance of ease of use by using regression analysis could be helpful in finding out whether or not this factor affected the level of EMR implementation. Using SPSS 19 revealed that the relationship between the perception of ease of use and the level of implementation of EMR was not significant enough to declare that perception of ease of use was a factor in determining the level of EMR implementation, as illustrated in Table 11. In summary, ease of use was perceived as generally positive among Eastern Province hospitals but this was not a critical factor in motivating them to move further in implementing EMR.

Table 11: The relationship between the EMR implementation level and perception of ease of use

Factor	R2	Sig	Significant at 95%
Ease of Use	14.8%	0.118	No

4.2.2.2.2 Perception of fulfilling needs

Unlike the perceptions of ease of use, perceptions as to whether the system fulfilled the needs of users varied widely. In general, as illustrated in Figure 18, no clear attitude toward this dimension emerged as more than 40% disagreed that the current EMR fulfilled their needs while 40% agreed. This could be because most organisations had not implemented EMR or because the system was indeed not useful.

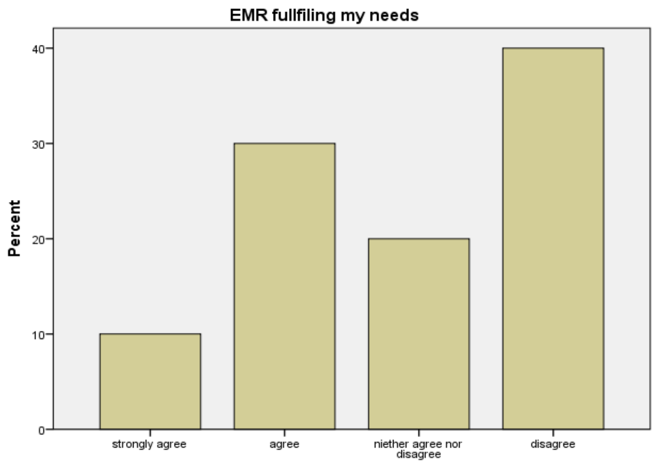


Figure 18: EMR fulfilling my needs

This variance in responses regarding the differences in perception in terms of fulfilling needs does seem to affect significantly the impact of implementing EMR. Indeed, as shown before, most hospitals have not yet implemented the system. This suggests that this figure represents whether or not the system could fulfil the needs; however, it does represent perceptions regarding its future use. Therefore, this is a positive sign in terms of motivation to implement. Indeed, the case studies conducted later were aimed to find out whether or not the system actually fulfilled the needs of adopters.

As shown in Table 12, there was no evidence that the EMR implementation level was a factor affecting perceptions as to whether the system fulfilled the needs of users.

Table 12: The relationship between the EMR implementation level and the perception that the EMR fulfilled users' needs

Factor	R2	Sig	Significant at 95%
Perception of fulfilling the needs	0.1%	0.905	No

In summary, there was no agreement among respondents about the benefits of the EMR in fulfilling the needs of users. Additionally, this perception did not have any impact on the level of EMR implementation.

4.2.2.2.3 Perception of fitness of EMR to the hospital system

Perceptions regarding the compatibility of the EMR with hospital procedures, standards and policies were relatively high. As shown in Figure 19, more than half agreed that it was compatible with the current state of the hospital while 25% disagreed. Indeed, this could be an indicator of motivation to implement of EMR in these hospitals.

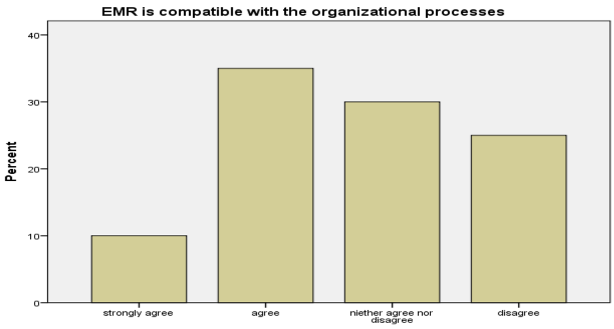


Figure 19: Perceptions regarding the compatibility of organisational processes with the level of EMR implementation

The regression analysis results shown in Table 13 do not provide sufficient evidence to claim that the compatibility of the system affects the level of EMR implementation.

Table 13: The relationship between the EMR implementation level and perceptions regarding the compatibility of the system with current hospital processes, procedures and policies

Factor	R2	Sig	Significant at 95%
Compatibility of the system with the hospital procedures, processes and policies	**12.1%**	**0.15**	**No**

4.2.2.2.4 Perception of enhancing the quality of care

In addition to the perception of fitness as an indicator of motivation to change, the belief in an EMR as an enhancer of quality is also an indicator. As illustrated in

Figure 20, only 10% of the hospitals did not believe that the EMR functioned as an enabler in enhancing the hospital's quality.

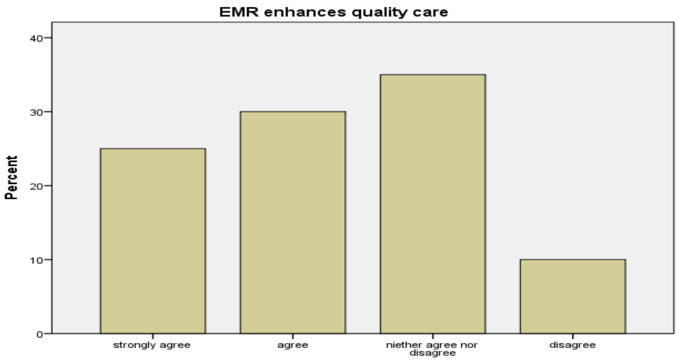


Figure 20: EMR enhance quality care

From a co-relational perspective, as tabulated in Table 14, perceptions with regard to enhancing the quality of care were revealed to be a critical factor in determining the level of EMR implementation in hospitals. The more staff believed that EMR enhanced care, the more the hospital had implemented the EMR. In other words, it can be restated that, the hospitals that had implemented EMR perceived something differently from those who had not: i.e., the quality of healthcare.

Table 14: The relationship between the EMR implementation level and perceptions that the EMR led to enhancing the quality of care

Factor	R2	Sig	Significant at 95%
Perception of enhancing the quality of care	65%	0.003	Yes

4.2.2.3.5 Organisational support

Another factor that motivated the implementation of EMR in the hospitals was organisational support. As illustrated in Figure 21, only 20% of the studied organisations disagreed that there was organisational support to implement the system.

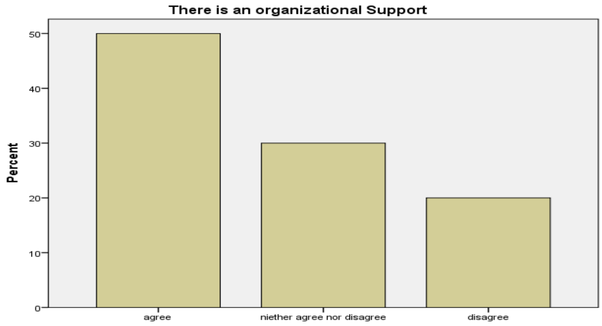


Figure 21: There is an organizational support

Indeed, based on the regression analysis summarised in Table 15, there was strong evidence that organisational support was a factor in determining the level of EMR implementation. This means that organisational support is a driver in further implementing EMR.

Table 15: The relationship between the EMR implementation level and perceptions of organisational commitment and support to implement

Factor	R2	Sig	Significant at 95%
Organisational Support	23.5%	0.04	Yes

4.3 Summary and Conclusion

Hospitals in the Eastern Province of Saudi Arabia varied are varied widely among the hospitals. However, as illustrated in Table 16, only the perception concerning the EMR's ability to enhance quality and the existence of organisational support were found to be drivers for implementing EMR in Eastern Province hospitals.

Table 16: Attitudes and critical motivating factors regarding EMR

Factor	Attitude	Critical Factor
Ease of use	Positive	No
Fulfilling the needs	Varied widely	No
Compatibility	Positive	No
Enhancing quality	Positive	Yes
Organisational support	Positive	Yes

Among the 29 hospitals, only four had implemented some EMR systems. Three of them had implemented more than one system and had some level of integration between them, whereas the remaining hospital had implemented only one.

Therefore, these three hospitals were selected have been for investigation and in-depth study; the results of this are presented in the following chapters.

Chapter Five: Results of Case Study One

5.1 Introduction

This case study concerns a hospital that had achieved stage four of implementation but has now returned to stage 1.

This chapter starts by considering the context of case study 1 in terms of size, functions, IT infrastructure, and level of EMR implementation. Afterward, as illustrated in Figure 22, the data collection methods used in this study are explained. Finally, before stating the conclusion of the chapter, results and findings from the quantitative and qualitative analyses are presented.

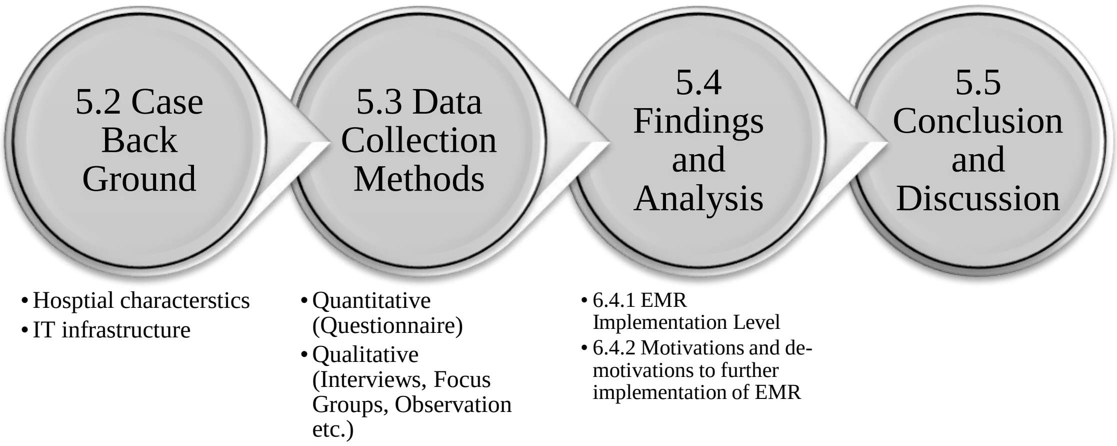


Figure 22: Structure of chapter 5

This hospital was founded in 1984 in the capital city of the Eastern province. It is a 450-bed Ministry of Health hospital which provides free medical and surgical services to citizens and eligible expatriates in the region. The hospital provides a wide spectrum of services that include ambulatory, emergency, inpatient and home care. The scope of services includes surgical units, internal medicine units, day surgery, intensive care, a Rehab. Centre, Dental Centre, Endoscopy Dept., a Burns Unit, the Kano Kidney Centre, a Diabetic Centre, Lithotripsy, operating theatres, anaesthesia and a recovery room.

Throughout the decades, the hospital has had a consistent commitment to deliver the highest levels of clinical quality and to provide the best possible standards of personalised care to its patients. In 2010, the Saudi Central Board accredited the hospital for Accreditation of Healthcare Institutions (CBAHI) as one of the best performing hospitals in the Eastern Province. To meet the increasing demand for quality and excellence in health services, the hospital was planning to be accredited by the Joint Commission International (JCI) by 2015 but actually achieved this successfully in May 2014 with a high score.

The hospital is one of 30 hospitals across the Kingdom that uses a state-of-the-art, fully integrated hospital information system (HIS) sponsored by the Ministry of Health (MoH). The system is built around a unified Electronic Medical Record (EMR). This includes patient Administration, Laboratory, Pharmacy, CPOE, Radiology, Picture Archiving and Communication System (PACS).

5.2.1 IT infrastructure in case one

The Ministry of Health (MoH) has recently changed the name of its IT department to e-health in all hospitals. To improve healthcare quality for all residents, increase patient safety, lower healthcare costs and develop more effective health policies, the Ministry of Health strives to deliver the best services currently and in the future by automating the health services and integrating all EHR systems all over the Kingdom. The Saudi Ministry of Health (MoH) created the national Electronic Health EHR vision to allow the future integration and sharing of information across the nation’s healthcare system. The hospital uses the three core features of laboratory, radiology and pharmacy electronic systems.

5.3 Data Collection Methods

The methodology of this case study was a mixed-method approach, as can be seen in Figure 23. As explained and detailed in Chapter 3, four data collection tools were used: document analysis, questionnaires, interviews and focus groups.

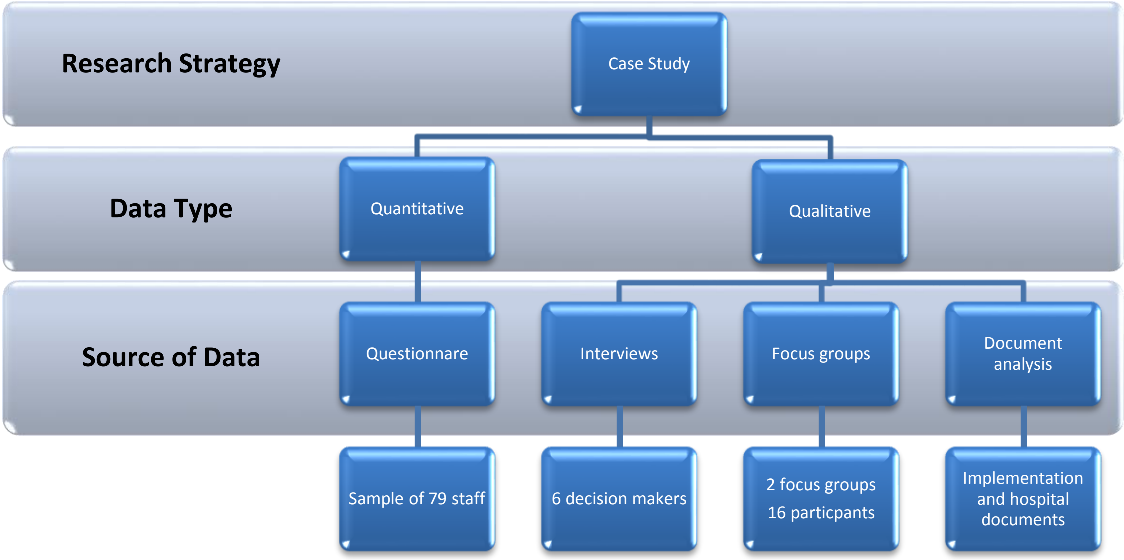


Figure 23: Data collection methods in Case 1

5.3.1 Questionnaire

The population of this case study consisted of all the EMR users within hospital 1; this consisted of 2000 staff members, including 400 doctors and 600 nurses. One hundred questionnaires were distributed randomly and 79 questionnaires were returned, a return rate of 79%. The respondents were from different departments. Roughly, two thirds of the respondents, as shown in Figure 24, were from medical and nursing departments as these were the most frequent users of the system.

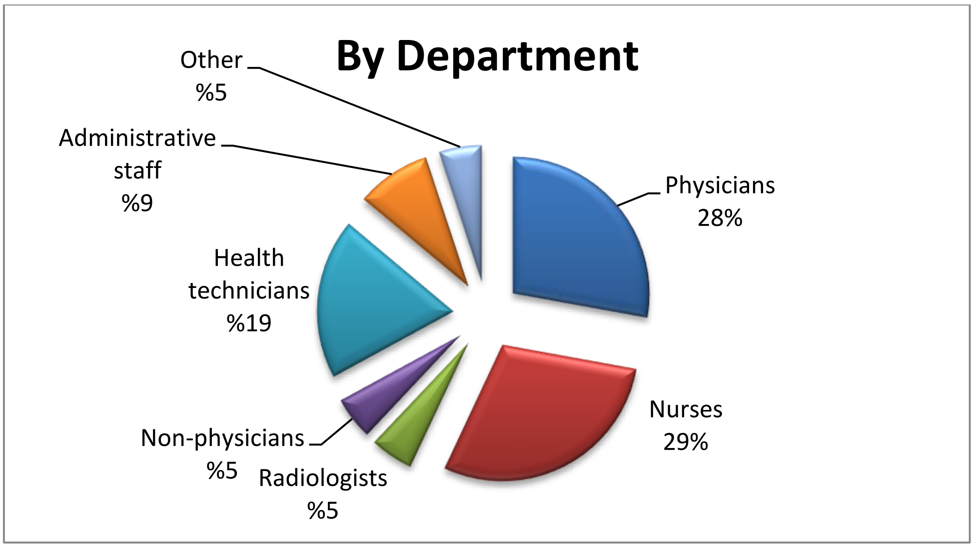


Figure 24: Survey respondents by Department

5.3.2 Interviews

Six individual interviews were carried out with decision makers, all of whom were seniors with more than 14 years' experience. As Table 17 shows, the interviews took on average 55 minutes.

Table 17: Interviewees' Profiles

Code Name	Interviewee's Position	Time	Years of Experience	Age Bracket
ID001	Chief of Nursing	55 m	14y	40-50
ID002	Chief Medical Director	50 m	16 y	50-60
ID003	Chief of IT	45 m	22y	40-50
ID004	Chief of Pharmacy	50 m	16y	40-50
ID005	Chief of Radiology	60 m	26 y	50-60
ID006	Chief of Internal Medicine	60 m	19 y	40-50

5.3.3 Focus Groups

In addition, two focus group meetings for doctors and nurses were carried out. The focus groups consisted of 16 participants in total, with eight doctors and eight nurses in each group. Both focus groups took on average the same amount of time: roughly two hours each. The ages of the doctors were significantly higher than the nursing participants since most nurses are new staff, as illustrated in both Tables Table 18 and Table 19.

Table 18: Profiles of doctors' focus group participants

Code Name	Interviewee's Position	Duration	Years of Experience	Age Bracket
FGD001		1:50		
P1	Chief of Surgery		23	50-60
P 2	Chief of Dermatology		10	30-40
P 3	Chief of Intensive Unit		12	40-50
P 4	Chief of Neurology		11	40-50
P 5	Chief of Urology		12	40-50
P 6	Chief of Accident and Emergency		8	30-40
P 7	Chief of Anaesthesia		22	50-60
P 8	Chief of Orthopedics		13	40-50

Table 19: Profile of nurses' focus group participants

Code Name	Interviewee's Position	Duration	Years of Experience	Age Bracket
FGD002		1:55		
P 9	MMW Head Nurse		8 y	20-30
P 10	FMW Head Nurse		7 y	20-30
P 11	FSW Head Nurse		13 y	30-40
P 12	MSW Head Nurse		9 y	30-40
P 13	ICU Head Nurse		12 y	30—40
P 14	Endoscopy Head Nurse		8 y	20-30
P 15	OPD Head Nurse		8 y	20-30
P 16	ER Head Nurse		13 y	30-40

5.4 Findings and Analysis

This section starts by defining and investigating the EMR implementation level and continues by investigating the factors which may motivate or de-motivate the further implementation of EMR systems.

5.4.1 EMR Implementation

Three systems of EMR are currently installed and running in this hospital: pharmacy, radiology and laboratory systems. As illustrated and explained in detail in the literature review chapter, these systems are the requirements for achieving stage 1. While various EMR systems had been used (e.g. nursing documentation, including vital signs; flow sheets; nursing notes and doctors' documentation systems), the CEO decided to halt the progress which meant the hospital nearly achieved level 4 and downgraded to level 1.

After an independent consultancy organisation conducted an EMR analysis for case 1 based on the hospital documents (Table 20) it was categorised as stage 1 as the system had been installed (stage 0) and basic features were being used (stage 1).

Table 20: EMR level of case study one

Stage	Description
Stage 1	• All Pharmacy functionality with batch control such as store transactions, drug dispensing, etc... • All Laboratory functions such as ordering, specimen collection, specimen receiving, work list for resulting, releasing and specimen tracking for quality control. • All Radiology functions such as ordering, scheduling, imaging, work list for reporting and tracking for quality control.
Stage 0	• Hospital structure setup • EMR administrations & privileges • Patient registration • Outpatient booking • Inpatient admission & transfer • Fast & normal ER reception registration functions

Only three systems were fully implemented and integrated: radiology, pharmacy and laboratory. However, other systems were partially implemented and the three existing systems are the basic systems required for other systems. The success of the EMR achieving its targeted objectives is based mainly on those systems as they are the main interfaces in terms of data collection and the system used for hospital processes. The following sections explain the state of each of these implemented systems in the case study hospital.

5.4.1.1 Radiology system

This system currently offers a 24 hour service delivery to in-patients and out-patients referrals. It utilises cassette-based and cassette-less digital radiography technology while medical imaging and patient information workflow are managed by digital data during exposure acquisition, image transmission, storage and display, and interpretation that influence the optimisation of the quality of patient care. The x-ray technologists performing digital imaging procedures are well trained in the proper use of the equipment, and in daily machine testing and check listing, making them better able to maintain health standards and minimise risks and hazards for patients and personnel. The General Radiology section uses advanced digital machines while workflow management is performed using a combination of a Radiology Information System (RIS) and a picture archiving and communication system (PACS) to enable integration between this system and the Health Level 7 (HL7) messages system.

The Magnetic Resonance Imaging Services (MRI) section provides a diagnostic service to both In-Patients and Outpatients. It takes referrals from clinics such as the Surgical, Internal Medicine, Lymphoma, Neurology and ENT Clinics. Frequently performed routine procedures include examinations of, for example, the brain, spine, abdomen and pelvis.

Medical ultrasounds use high frequency sound waves to obtain images of the body and the Ultrasound Diagnostic Service provides ultrasound scanning with the personal involvement of the radiologist. The Ultrasound Division performs on average 9,000 examinations each year; all studies are reviewed, stored and reported on a PACS system.

5.4.1.2 Pharmacy system

The Pharmacy Services Administration provides full systems-based services for patients, physicians, nurses, trainees and other healthcare practitioners. Unlike other systems, users are highly satisfied with the system as it is connected to other systems and facilitates their tasks significantly, as explained and investigated in this chapter.

5.4.1.3 Laboratory system

The laboratory functions are nearly fully integrated with the Blood Bank, Chemistry and Microbiology units. The Blood Bank and Transfusion Medicine Centre is composed of the Blood Donation Unit and includes the Mobile Blood Donation Drive, Donor Blood Testing Laboratory, Blood Components Production, a Transfusion Medicine Unit, Aphaeresis Unit (donors and patients) and a stem cell facility. The Centre provides a full range of routine, emergency and special transfusion services to patients of all ages, from children to adults, with a variety of medical and surgical conditions; it particularly supports the active multi-organ transplant programme.

The Clinical Chemistry division provides a 24/7 clinical laboratory service while Clinical Chemistry Services cover routine general chemistry tests, immunoassays of different hormones, therapeutic drug monitoring and sweat testing for CF screening.

The Microbiology and Histopathology Lab provides high quality diagnostic microbiology to support clinicians in the care of individual patients. It also supports the development and implementation of policies for the prevention and control of infectious diseases in the population, which will significantly improve public health. This service is performed in a regional lab, not an indoor one and is not integrated in the system; however, it still requires requests to be logged and received, and the results to be processed manually.

5.4.1.4 Summary of systems implemented

This case is unique from the other cases as it has already implemented many components; however, it has stopped using some of them (e.g., the Computer Physician Order Entry system and the Nursing Documentation system). Therefore, in Table 21, the rows are coloured to reflect four categories of systems: red (implemented but use stopped), yellow (used but not satisfactory to them), green (used and satisfactory), and blue (partly implemented). Indeed, these levels reflect the differences in attitude toward different components of the system. Pharmacy, radiology and lab systems are all installed and are satisfactory.

However, other ancillary components such as doctors' orders, progress notes and nurses' notes are not satisfactory. Therefore, this hospital stopped using these components due to many factors which are presented and clarified later in this chapter, together with a summary of quotations to reflect why the use of these components had been stopped. These are presented in Table 21. As clearly shown in the same table, it can be said that this case had achieved level four but, because it stopped using many components, it returned to level 1. This means that this case faces problems other than financial ones as it has sufficient financial resources to buy, install and implement components to take it to level 4. Thus, there were other factors that needed to be investigated and this is explained in the following sections of the chapter.

Table 21: EMR components

L		Implementation Level	Comment
1	Pharmacy	Installed + Used+ Satisfactory	Pharmacist says "*The system's full implementation helps a lot in medication management processes*"ID004
	Radiology	Installed + Used+ Satisfactory	A doctor says, "*The radiology is also completely computerised. **Now you can request X-rays from any location**... the clinic, the ward, A&E. Then radiology introduced BACS and **it is fully integrated** with the system.*" FGD001-P8
	Laboratory	Installed + partly used + satisfactory with conditions because of ***integration problem***	"*No problem with the inside laboratory; the problem is with the regional lab: it is not connected to the hospital system and they use a different system. We do not have direct access to histopathology and microbiology reports. The two systems **do not communicate**"*ID006
2	Clinical Data Repository (CDR)	Installed + partly used because there are sub-systems that have not been implemented, such as pathology system	
	Control Medical Vocabulary	Installed but users are not aware of it	A doctor says, *"I have problems with our clinical coders. They want me to write the diagnosis in a terminology that is consistent with what is available in the software. If different words are used, **the system will not accept them**. They are really giving me **hard time**"*. FGD001-P7
	Clinical Decision Support	Installed + partly used because of ***Integration*** between Lab system and other systems	Head of Pharmacy says, "*When a **doctor** issues a prescription, **drug interaction** helps doctors to ensure they have the right medication*". A lab doctor says "*If we have complete lab competence integrated with the system we will be happy as pharmacy and x-ray*" ID004
3	Nursing Clinical Documentation	Installed but stopped using because of the ***IT infrastructure***	A nurse in a focus group said, "We *used to use both manual and computerized systems but we stopped that because it was time consuming. Patients complained to the hospital director. Afterward, we stopped using the system **because computers are too slow to be used**; we just view the investigations reports and prescribe the medication through the system*" FG002-P11
	Picture Archiving Communication System (PACS)	Installed + used + satisfactory Because of ***integration***	A doctor describes this as "*This is one of the bright things about the EMR and the PACS*" FGD001-P5 Another one says, "*There is no problem with the PACS system. It is already **integrated** with the EMR*" FGD001-P3
	Clinical Documentation	Installed and not used because it is an ***output system*** for other systems – the problem is in ***integration***	

4	International Classification of Disease (ICD-10)	Installed but not used because of the ***Vocabulary problems*** and ***un-awareness of the existence of it***	*"We need clinical documentation to activate the ICD10 and standard vocabulary"* ID006
	Computer Physician Order Entry (CPOE)	Installed but stopped using it. Because of ***perception of time consuming***	Doctor says "*we used to write the orders in the system but we stopped that system because it is not **friendly to use:** it **takes time** and we have to write it in paper and system in the same time*" FGD001-P4
	Clinical Decision Support System		Installed but not used because the previous levels have not been fully implemented, as these systems depend mainly on the availability of the data.
5	Closed Loop Medication Administration		
6	Physician Documentation		
7	Complete EMR		

Red: Used but stopped using it   Green: Used and satisfactory   Yellow: Used but not satisfactory   Blue: Partly used

White: Installed but have not ever used it

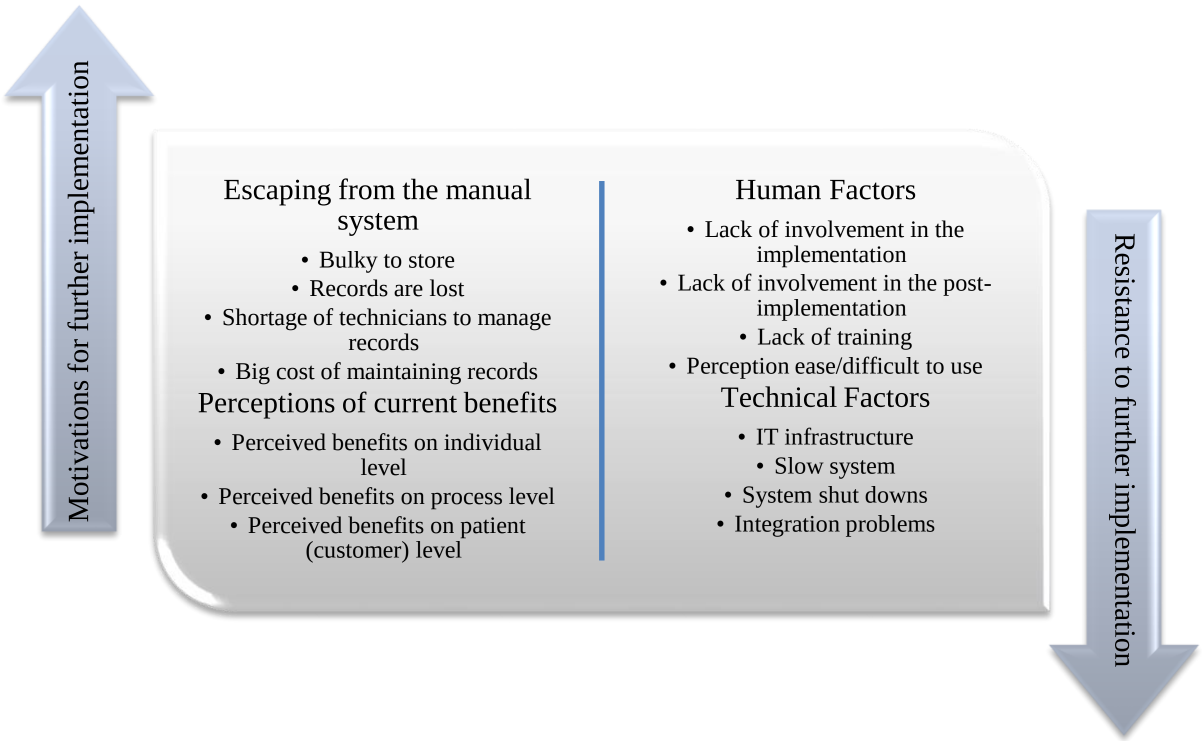
5.4.2 *Motivational or De-motivational Factors to Further Implementation*

There seemed to be a range of factors that motivated or de-motivated staff at the case study one site to adopt a higher level of EMR implementation, as illustrated in Figure 25.

Factors acting as a motivation to go forward were classified as escaping from the previous manual system and perception of the benefits realised from the current electronic system at the level of users, processes and patients. However, there were human and technical problems that seemed to de-motivate employees from achieving a higher level of implementation.

Human problems included: the level of involvement of employees in the time required for implementing the system, which affected their level of involvement in post-implementation; and lack of training, which affected the perception of ease of use. Besides the human problems that affected any future implementation, technical problems also appeared to lead to employee frustration. Frustration may have been because of the slow systems or system crashes, which happened because of using old computers, an insufficient number of computers, inferior connectivity on the network, and a disintegrated system that led to duplicated work. Most of the findings can be roughly summarised in this statement made by a nursing director:

> *"I cannot deny there are many benefits of EMR, such as decreased number of medication errors, improved patient safety, quality of care, patient satisfaction, better communication among the staff and better confidentiality and security of patients' information. But, you must get the right software, you know. It is not good to solve some problems in some areas and create new ones in other areas. Our current programme is too slow, full of defects and very frustrating for doctors and nurses."* ID001



5.4.2.1 Motivations for further EMR implementation

Figure 25: Motivations and resistance to further implementation

In general, there is a positive attitude toward the EMR in the first case, as roughly 70% of respondents more than agreed that the system is not stressful for them to use, as illustrated in Figure 26.

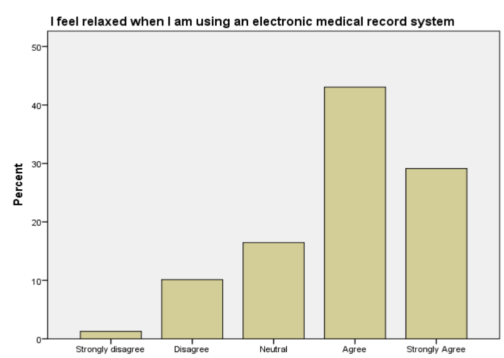


Figure 26: I feel relaxed when I am using an electronic medical record system

Two main factors, based on the quantitative and qualitative analysis, motivated staff at this site to proceed in implementing the system, as illustrated in Figure 27. Errors due to human intervention in recording and transferring data, the bulkiness of paperwork, and the high cost of maintaining it seemed to be factors that may have led the organisation to leave/discard the manual system. Additionally, the centralisation of the manual paper records had led to further problems such as an inability to share the data and difficulty in accessing it. Besides the desire to move from the manual system, the current electronic system was perceived as useful for users, processes and patients.

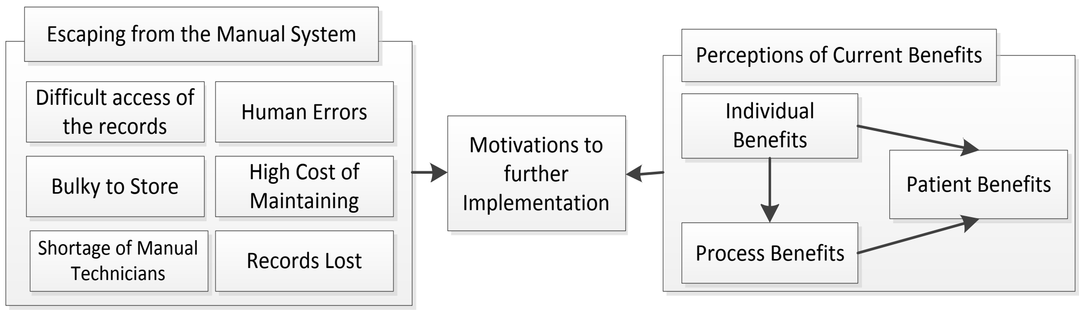


Figure 27: Motivational factors for further implementation

5.4.2.1.1 Escaping from the manual system

There was a significant perception among respondents in case study one that they were uncomfortable with the old manual system. Quantitatively speaking, as illustrated in Table 22, there was average agreement on the following points:(1) the use of EMR is better than the manual system; (2) using EMR is more helpful than the manual system; and (3) there is a preference for EMR over the manual system is since agreement was shown at a level of 4.39, 4.51, 4.35 points out of 5, respectively. Additionally, the standard deviation, which illustrates the level of differences between responses, was only 0.79, 0.68, 0.89 points (out of a score of 5) respectively, which means the respondents were very consistent in their grading on these statements.

Table 22: Statements about the comparison between the manual system and the new EMR system

Statement	Mean	StDeviaton
Using electronic medical record systems in the hospital is better than using manual records.	4.39	0.79
Using electronic medical record systems in the hospital is more helpful.	4.51	0.68
If I had to choose between the electronic medical record and the manual, I would choose the electronic.	4.35	0.89

Moreover, as illustrated Figure 28, more than 70% of the respondents believed that the current electronic system was better than the manual system. Consequently, there was a positive attitude toward the electronic system from the perspective of escaping from the manual system. Therefore, an analysis of the qualitative data was utilized to investigate why they were uncomfortable with the manual system.

The reasons why respondents may have preferred the electronic system were classified into four themes. As the manual work was based mainly on paper work, the difficulty of storing records was a headache for some users. The paper work also cost a lot to maintain and preserve and also required special technicians to index and retrieve the information.

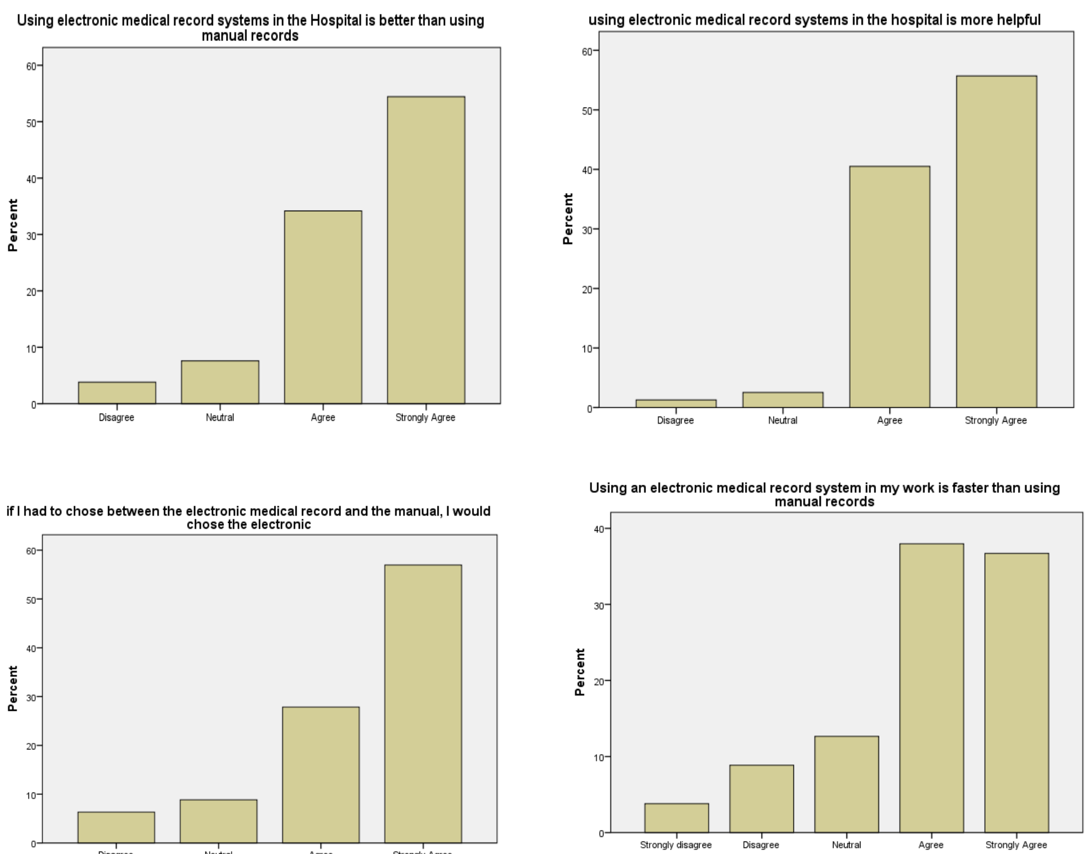


Figure 28: Attitude toward EMR

I. Bulky to store

One of the first queries presented to the interviewees concerned the challenges faced by the organisation due to the absence of EMR systems. This line of inquiry led to observations of the numerous disadvantages that the Paper-Based system imposed on this hospital's staff and users of medical data.

At the forefront were the challenges that arose from the use of Paper-Based Health Records. The bulk created by this type of filing system was inconvenient to store and so emphasis was placed on a new requirement. For example, one participant in the interview highlighted storage space as an issue:

> *"Every few months the hospital had to find additional space for the medical records. Finding space for inactive files was another problem."* ID006

This issue was not just restricted to files in use but also to those that had been dormant for some time. Another participant agreed on the same point of the requirement for space for storing data, and he showed that the EMR solved this problem by its ability to maintain the files in the system for long time.

> *"Another important impact is that we can maintain images for several years without the need for more space."* ID005

II. Records are lost

A more pressing issue discovered through the analysis of the data was that during the usage of Paper-Based Systems, Patient Medical Record files were frequently lost. As one participant described:

> *"Loss of medical records file, loss of laboratory and radiology reports…. All these problems affect the continuity of patient care."* ID001

Misplacement of X-rays and diagnostic reports was a common occurrence. For example, a nursing director said in the interview,

"We faced problem like missing medical records file, lost diagnostic reports." ID001

This would create a delay in the treatment of a patient or, in extreme cases, even cause a deterioration in the patient's health if immediate treatment was required. It is clear that any misplaced health records would be detrimental to effective and efficient patient care. Ultimately, this issue put the hospital's services under scrutiny. This finding could be summarised by the Information Technology Director:

> *"So many problems. Missing medical records, lost laboratory reports and missing X-ray films (pause), there were problems with patient safety and quality of services."* ID003

Loss of records was a common and thereby crucial issue to consider. The Chief of the Radiology Department described how they were not available when needed:

> *"Too many … a very long list, I should say. To mention some, I would start with the loss of X-ray films and reports. You know that is a real problem. X-ray films and reports were not always available to the doctor when needed. Imagine how the doctor and the patient feel when radiology images and reports are not available. Very frustrating for both of them, isn't it?"* ID005

Because of the complications caused by using a Paper- Based System, it was the patient that was affected the most as "*these problems resulted in poor continuity of patient's care, poor quality and many medication errors"* ID006. To sum up, there was an agreement in the focus group regarding this statement made by a doctor:

> *"Actually, we faced many problems. First, it was the **unavailability of the paper based medical records** at the point of care. Second the frequent **loss of laboratory and radiology reports**. You know, these affected the continuity of patient care."* FGD001-P3

III. Shortage of technicians to manage records

It can easily be understood that the aforementioned bulk of Paper Records would require staff whose duties included organising the records and tracking them down when needed. Given this, the study found that many of the hospital staff felt that, despite the need, there were not enough technicians and those that existed were perhaps stretched by the quantity of records. One Medical Director showed this by saying:

> *"There are many other problems, like shortage of medical record technicians."* ID002

The problems of storage and insufficient staff went hand in hand, as a Head of Internal Medicine said:

> *"There was also the filing space problem (pause), and medical record staff problem. You know we needed more space. Every few month the hospital had to find additional space for the medical records. (Pause), finding space for inactive files was another problem. You also need too many staff for filing, retrieving, mounting investigation reports, controlling the forms (smiles) too much work."* ID006

For some interviewees the two were simultaneously causal. The shortage could perhaps be explained by the impracticality of hiring large numbers of staff for such a basic task as handling paper work.

IV. High costs of maintaining records

This issue was interrelated with the ones discussed previously. There were costs associated with the hiring of technicians, allocating storage space for records, and the purchase of materials for Paper-Based Records. These problems were clearly described by one medical director:

> *"There are many other problems, like shortage of medical record technicians and the high cost of maintaining paper-based medical records."* ID002

It is no surprise that the hospital under consideration would want to move away from the high cost of a Paper-Based System to a less costly (at least in the long run) EMR system:

> *"There are other motivations such as decreasing the high cost of processing and maintaining paper-based X-ray films and reports."* ID006

The problem was exaggerated when it came to X-ray films. X-ray films are heavy, difficult to move from place to place, and expensive to maintain. Not only was it burdensome to carry heavy X-rays from one corner of the hospital to the area concerned, there was also concern over the durability of these images in the long-run. Furthermore, records could only be accessed in one area at a time. A doctor, enthusiastically, explained how the EMR had changed the way of working as follows:

> "*Easy access to X-ray images, besides reduced cost and efforts. Another important impact is that we can maintain images for several years without the need for more."* ID005

Furthermore, the head of internal medicine explained how much the new EMR system was important to them:

> *"The EMR has many benefits for patients and staff, such as improving patient safety and the quality of care. (Smiles) let me tell you about the benefits of the PACS system. X-ray films can be seen on computer at any location in the hospital and at any time. The PACS improved our productivity and efficiency. Do you know that traditional X-ray films cost our hospital around 2 million Saudi Riyals annually? Yes, that is true, our statistics tell us this. The PACS system saves us a lot of money."* ID006

5.4.2.1.2 Perceptions of the current benefits

Perceptions of benefit appeared to have affected the further implementation of EMR in this case. As employees feel they are more productive, their willingness to adopt EMR further increases. Likewise, the perception that the process of providing a service is improved by the system affects middle level managers' willingness to implement the system further. Indeed, the higher the productivity of the user, the higher the process productivity will be. Additionally, the perception of patient satisfaction derived from the system, which could be because of the higher productivity of the users and processes, is increased because of the system. This argument was supported by the Head of the Pharmacy Department who said:

> *"In my opinion patient safety is the motivator. I think we need to improve patient safety through decreasing medication errors and improving medication management processes. There are other motivations, you*

know. I mean we want to improve the productivity and the flow of the service, and improve the quality of data and information for appropriate decision-making." ID004

Therefore, the senior and middle level managers had become more open to further implementation of the system. All of this could be summarised by the explanation of a Nursing Director below:

"Facilitating the continuity of patient care, decreasing medication errors, ensuring that all diagnostic reports are available for doctors on the computer, decreasing the cost of paper based medical records, are all benefits of the EMR that makes it invaluable. (Pause) Accreditation, you know accreditation is one of the main drivers for adopting EHR." ID001

I. Benefits from a user perspective

Although, quantitatively, it was perceived that the current EMR system does not provide much to meet users' expectations in terms of benefits, employees believe that the EMR could have great potential if they implemented it further and received more training on it. Indeed, the impact of the current EMR on productivity enhancement was relatively low, as about 45% of respondents disagreed that the EMR increased their productivity (as illustrated in Figure 29).

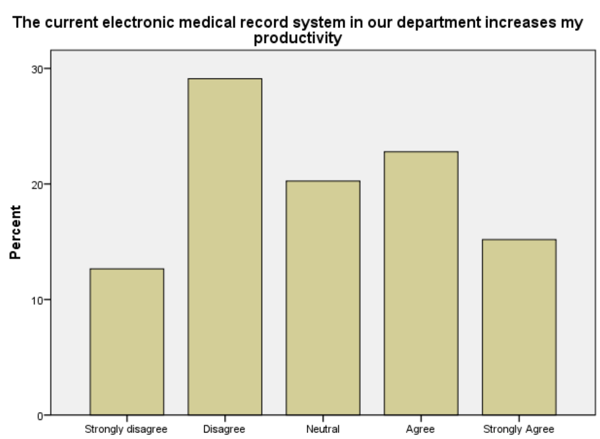


Figure 29: the current EMR system in our department increases my productivity

However, employees believed that the main reason restricting their ability to increase productivity via the system was the current IT infrastructure, particularly in terms of old and insufficient computers, as well as the lack of integration between systems. From a pharmacy perspective, as this area had implemented the system completely, EMR had enhanced their day-to-day operations by helping those identifying chemical interactions between different drugs. As noted by the Director of Pharmacy:

> *"The system helps to identify drug to drug interaction, it helps identify drug to food interaction, medication management processes are improved, improved flow of processes and increased productivity."* ID004

II. Benefits from a process perspective

It was widely agreed that EMR has improved the communication across departments (average agreement was 3.81). As a result, errors due to double entry of data between different departments had decreased. Roughly, 70% accepted that EMR had decreased medical errors significantly, as illustrated in Figure 30. Additionally, more than 60% of employees believed that EMR decreased unnecessary medical testing (efficiency of work). Moreover, it was widely perceived that EMR increased communication and collaboration across departments, with 70% agreeing and strongly agreeing, as illustrated in Figure 31. Because of these benefits, 70% of employees agreed that EMR increased productivity in their departments.

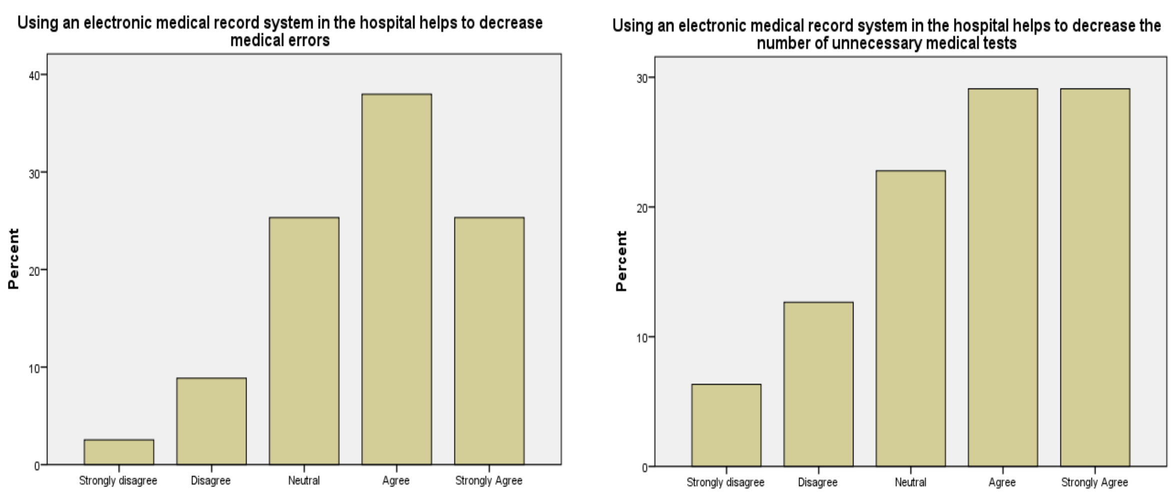


Figure 30: Using an EMR system in the hospital helps to decrease medical errors and unnecessary medical tests

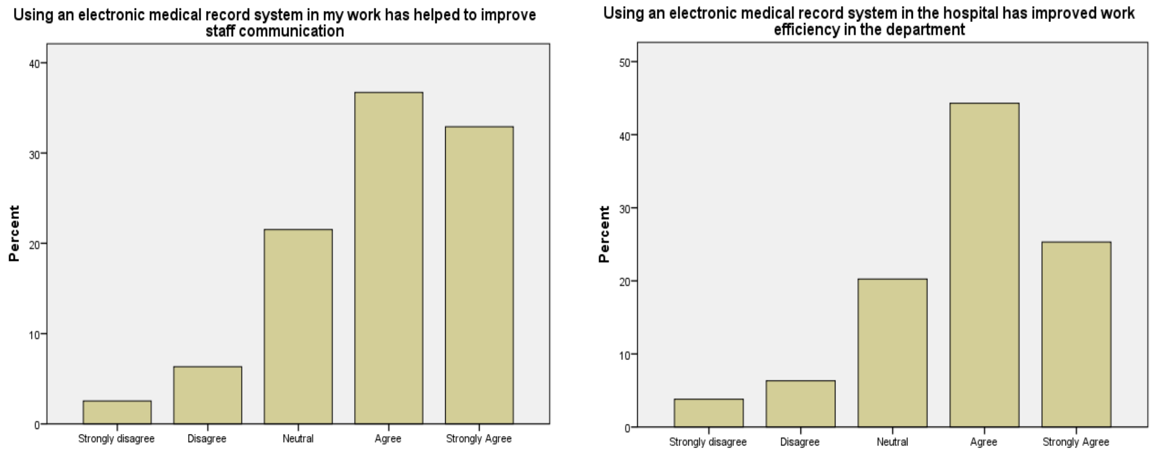


Figure 31: Using an electronic medical record in my work has helped to improve staff communication and improved work efficiency in the department

The process benefits came from the ability to share files across departments. Therefore, the availability of timeline data was valued by decision makers and appeared to motivate them to further implement the system. As the Nursing Director said:

> *"In my opinion, the first motivator is to ensure availability of medical records in a timely manner to the medical staff. This means quick access to patient's clinical information and continued patient's care. The second motivator is to improve the quality of the medical services and enhance patient safety. All these lead to employee and patient satisfaction."* ID001

Furthermore, some benefits were limited by the training hours received by employees. This was very clear from an Internal Medicine Director's words:

> *"The physician can see his/her waiting list on the computer in his/her clinic. I think there are many potential benefits but we have not yet fully implemented the system."* ID006

III. Benefits from a patient perspective

Patient satisfaction appeared to be a main motivator to implement EMR and continue implementing it, as an IT director said:

> *"I would say the patient is the main motivator. You know patients want good and safe care."* ID003

Quantitatively, EMR was perceived as enhancing patient satisfaction by enhancing the quality of patient care, maintaining the confidentiality of patients' information, and increasing patients' privacy. Indeed, it was perceived by 70% of the survey respondents that EMR enhanced the quality of patient care, as illustrated in Figure 32. For instance, making appointments was perceived as becoming faster and more convenient for patients, as the head of Internal medicine said:

> *"Now we can give appointments to patients in the clinic instead of sending them to the appointment section to register the appointment."* ID006.

Indeed, respondents perceived there to be many benefits of EMR at a patient level, as stated by the Nursing Director:

> *"I cannot deny there are many benefits of EMR, such as decreased number of medication errors, improved patient safety, quality of care, patient satisfaction, better communication among the staff and better confidentiality and security of patients' information."* ID001

Supporting this, there was a strong belief that EMR enhanced the confidentiality of patients' information, as illustrated in Figure 32. As clearly shown above, in the words of the Nursing Director, using EMR was perceived to enhance the process, decrease waiting times and lead to higher patient satisfaction. The Director further added:

> *"The first motivator is to **ensure availability of medical records** in **a timely manner** to the medical staff and this leads to **patient satisfaction**"* as one medical director says." ID001

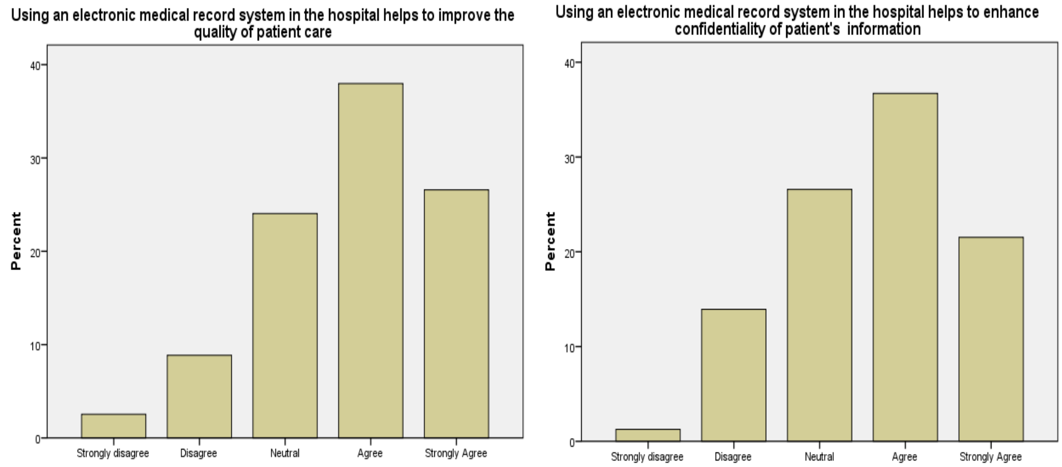


Figure 32: Using an EMR system in the hospital helps to improve the quality of patient care and enhance confidentiality of patient's information

5.4.2.2 De-motivations to further implementation

Although there were many perceived benefits of using the system, as previously noted, the satisfaction level with regard to the current system was not strong, as roughly 45% of the respondents were not satisfied (as illustrated in Figure 33). This dissatisfaction leads to resistance to further implementation of the electronic system.

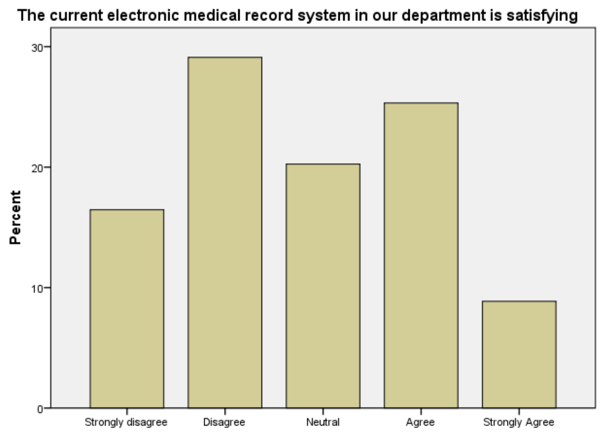


Figure 33: The current EMR system in our department is satisfying

According to the qualitative and quantitative analyses, this resistance seemed to be rooted in both human and technical factors, as illustrated in Figure 34. Human factors seemed to be triggered by the lack of involvement in the implementation phase, as well as insufficient training on the system. Lack of involvement in the implementation seemed to make employees feel uninvolved in the post-implementation, since they did not feel ownership of the system; they felt forced to use a ready-made system that was perhaps not applicable to their work. Additionally, insufficient training was found to be a factor in the perceived difficulty of the system and in its low utilisation.

From the perspective of technical problems, the IT infrastructure, in terms of a lack of computers, slow computers and the poor integration infrastructure, was found to have a critical impact on resistance to the system, since infrastructure problems can lead to a slow system, system breakdowns, and integration problems with other systems; this led to frustration and resistance to change.

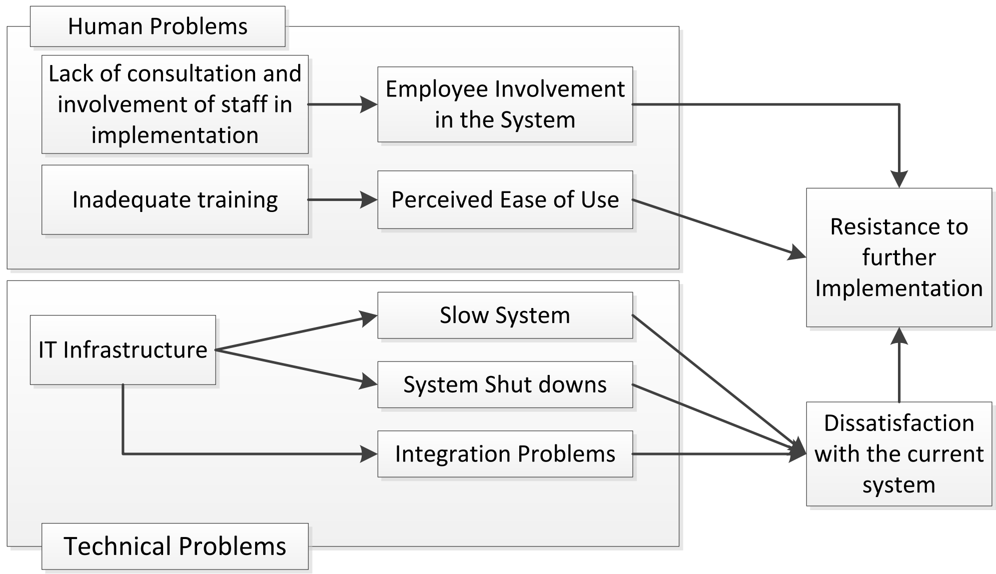


Figure 34: Factors affecting resistance to further implementation

5.4.2.2.1 Technical Problems

Case 1 appeared to face technical problems that led employees to feel dissatisfied with the system. Although there was a perception of improvement due to transferring from manual to computerised work, the satisfaction of employees toward the system, according to the survey, was, on average, below 3 points out of 5. This is illustrated in Table 23 and visually presented in Figure 35. This may be partly due to frustration over technical problems, as detailed in the following sections.

Table 23: Questionnaire responses regarding satisfaction with the system

Statement	Mean	SD
The current electronic medical record system in our department is stimulating	2.94	1.24
The current electronic medical record system in our department is satisfying	2.81	1.18
The current electronic medical record system in our department is wonderful	2.63	1.29

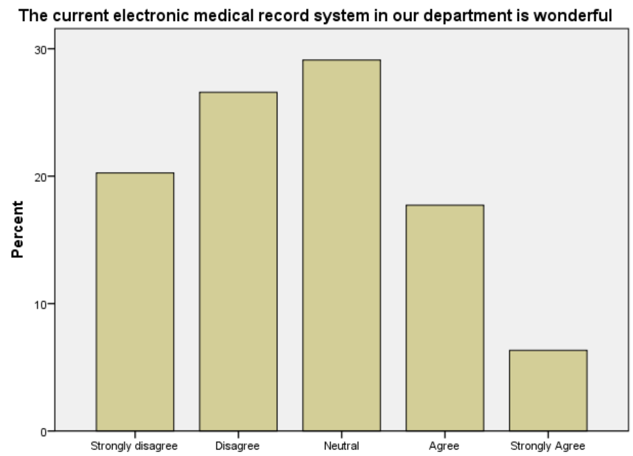


Figure 35: The current electronic medical record system in our department is wonderful

5.4.2.2.1.1 IT infrastructure problems

Infrastructure problems are those that are related to the quality and quantity of an information technology infrastructure. For instance, if the number of computers is not sufficient for the users, as illustrated in Figure 36, it can lead to bottlenecks in processes. Consequently, the speed of the process is slowed which in turn leads to employee frustration. Likewise, if computers are out of date, too slow to be used efficiently, often shut down, or if maintenance could disrupt the work significantly, these may also lead to dissatisfaction.

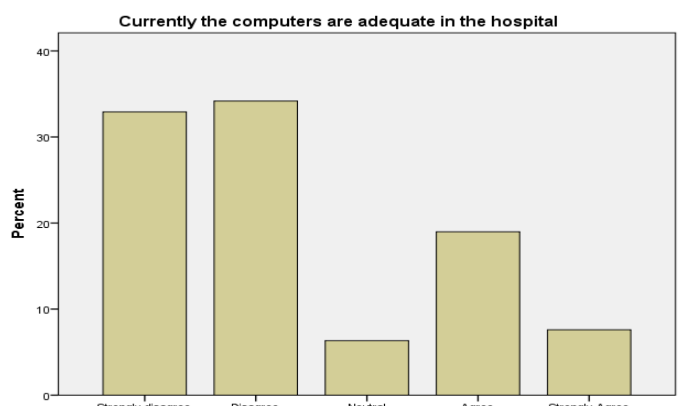


Figure 36: Currently, the computers are adequate in the hospital

Indeed, it was widely perceived that there were *"not enough (computers) for the staff"* ID003. Without sufficient computers, the staff could not carry out their routines smoothly. This was described clearly by the Medical Director:

> *"Can you imagine that every five doctors share one computer? In some units there is one computer for all doctors and nurses in the unit*." ID002

Even the Directors of Information Technology who were interviewed appeared to understand the issues arising from the deficiency:

> *"The **infrastructure is not appropriate**, computers are **old and are very few** in number compared to the number of staff."* ID003

According to the interviewees, the shortage had persisted since the commencement of the project:

> *"...The infrastructure is not complete until now. You know, our computers are very old and their number is not enough for the staff, and cables are very old. We work under great challenges."* ID003

In addition, it was reported that doctors and nurses often ended up sharing the same computers, which can also be problematic, as shown in the following statement:

> *"In our unit doctors and nurses share one computer. There should be a separate computer for nurses."* FGD002-P11

Apart from the inconvenience it caused, another problem highlighted by participants was the loss of time waiting one's turn:

> *"With the shortage of computers we wait for hours to enter our notes."* FGD002 –P10

These IT infrastructure issues have led to many other problems such as that noted by a nurse in the focus group:

> "*The computer's old mouse freezes and the keyboard does not respond. This makes me very frustrated and handicapped. I prefer the traditional*

paper based medical record because it does not hang or freeze." FGD002-P13

Other members of this focus group supported this statement. For instance, other nurses agreed strongly with this statement, one of them adding,

> *"We also need computers. Our computers are old and deficient in number; that is a big issue."* FGD001-P7

Indeed, this point was mentioned many times in other interviews, as one IT director admitted:

> *"You know, our computers are very old and their number is not enough for the staff."* FGD001-P4

Furthermore, one of the clear themes regarding the unreliable infrastructure was the connection between computers and servers as cables are perceived to be too old to be used. The IT director said:

> *"There were many concerns in the past and there are many concerns in the present. (With sad voice), the infrastructure is not complete until now. You know, our computers are very old and their number is not enough for the staff, and* ***cables are also very old****."* ID003

In summing up the scale of the IT infrastructure problems, as illustrated in Table 24, the interviewees in case study one seemed to feel frustrated because they were using old and insufficient computers; they were also frustrated by bad connectivity in the network caused by using old cables.

Table 24: IT Infrastructure sub-themes

Theme	Sub-theme
IT infrastructure problems	Old computers

	Number of computers is not sufficient
	Unreliable network – old cables

5.4.2.2.1.2 Slow System

The slow system speed has led to increased frustration among staff and this lack of speed was thought to be a critical reason for resisting the system by some participants in the focus groups, as mentioned by a doctor in one of the groups:

> "*System slow, computers freeze, lost information, shutdowns, backup, maintenance……they complain about everything. What I want to say is that, we should buy good computer-ware, prepare good infrastructure."* FGD001-P2

Another Director's understanding of the issue went deeper:

> *"Our current programme is too slow, full of defects and very frustrating for doctors and nurses."* ID006

The slowness in browsing has led them to believe that *"it is slowing our work flow"* (FGD002-P12), as noted by one of the participants in the focus group. Additionally, another participant in the focus group suggested that:

> *"This system is slowing my work, it's reducing my productivity and decreasing the time I spend with my patients. I have to spend too much time entering data into the computer."* FGD001-P7

In summary, as illustrated in

Table **25**, the slow system was criticised for wasting the time of staff and therefore reducing their productivity. Therefore, it seemed to be one of the critical factors producing feelings of frustration toward the EMR system and predisposing users against implementing it further.

Table 25: Integration problem sub-themes

Theme	Sub-theme
Slow System	Reduction in productivity
	Frustration
	Wasting time

5.4.2.2.1.3 System shutdowns

System shutdowns mean that the electronic system does not respond to requests. This can either be an issue with using obsolete computers or may be due to software issues. The staff reported that this was a common reason for a lot of system failures, for example:

> "*I believe I need this system. But, with the system we have, there are problems slowing our work like when there is system shutdown or power cut off.*" FGD002-P16

This type of failure raises questions about implementing EMR because of the risk of losing all information due to a minor break down. This appeared to be a significant source of frustration for some staff, for example:

> *"This system is not reliable. It can shutdown at any time, leaving you in a very embarrassing situation. You never get backup in time. It is very frustrating for both the physician and the patient."* ID006

The problem does not stop at the point of the breakdown itself. Maintenance is also an issue for the hospital and repairs could be lengthy:

> *"You have to wait for a long time to have a computer problem fixed by the IT department."* FGD-001-02

This delay could be explained by a "shortage of IT professionals." This is similar to the paper-based system which ran short of technicians. Any information lost would be very difficult replace and therefore, as one participant noted:

> "*They must take good precautions for these sudden shutdown and power failures. As a result, this puts a headache for the staff. Additionally, they must not put the medical staff under the stress of the potential risk of losing access to the clinical information, due to power failure or computer crash at any time*." FGD001-P8

As shown in Table 26, the shutdown problem was reflected in interviewees' belief that the system was not reliable in terms of its ability to access the data and provide support in difficult times. All of this led to frustration with the system, which might discourage further implementation.

Table 26: System shutdown sub-themes

Theme	**Sub-theme**
System shutdown	Slowing the work
	Losing the data
	Fixing time is long → shortage of IT technicians
	Stress (of continuous precautions and of not accessing the data at peak times)

5.4.2.2.1.4 Integration problems

A lack of integration in any area in the hospital was primarily dependant on whether that area had been fully computerised to work with EMR. From the documents available, it was clear that the pharmacy and radiology departments were completely computerised and were enjoying the associated functional advantages. Nevertheless, the data showed that systems were unable to communicate, leading to a plethora of systems. For instance, with regard to the Histopathology Department, a participant noted:

"Results come after 2 months and sometimes for 6 months, and some are lost." FGD001- P6

The inability to communicate reflected the integration problems across different systems.

"You are talking about integration of the two systems. They are not integrated. Not like the PACS. I wish they could solve this problem quickly. There are many deficiencies with our programme." FGD001-P8

Because of this, other participants in this focus group described a lack of direct access:

"We don't have direct access to histopathology and microbiology reports." FGD001-P2

In probing this problem, other side issues were revealed. Doctors and nurses shared log-in credentials to be able to access different systems easily.

"I have great difficulty accessing laboratory reports from the regional laboratory. We get the results from the website of the regional laboratory. We have to enter the patient's identification data every time we enter the website. Every five or six doctors share one password. It is time consuming and there are concerns about confidentiality and legal responsibility." FGD001-P5

In summary, integration problems are one of the main demotivations for the case one hospital and these are deterring them from adopting EMR further. As shown in

Table 27, integration problems were reflected not just in connection problems necessitating doubling entry and therefore wasting time, but also in confidentiality problems, as data were not secure in terms of their usability among different users.

Table 27: Integration problem sub-themes

Theme	Sub-theme
Integration problems	Connection
	Confidentiality problems
	Wasting time

5.4.2.2.2 Human problems

5.4.2.2.2.1 Lack of consultation and involvement of staff in implementation

The low level of involvement in the implementation phase could be because the EMR implementation was enforced by an external authority, the MoH. Since the implementation of the EMR system was driven by the Ministry of Health, little thought was given to planning for the implementation itself. Furthermore, decision makers perceived that EMR implementation was a matter concerning the willingness of the MoH; this did not necessarily reflect their own willingness, as noted by a Nursing Director:

> *"Everything was done centrally by the MoH.*" ID001

Moreover, others restated this point: i.e., that the EMR implementation reflected the MoH's desire, not the requirements of hospital decision makers. This point was made explicitly as follows:

> *"The system has been imposed by the MoH without any input from the staff."* ID004

Indeed, this negative feeling of an external organisation enforcing the hospital was reinforced when combined by the lack of participation of the hospital's decision makers in the EMR implementation. Intuitively, it makes sense that users of the software are better equipped to make decisions than those external to the hospital (e.g. the MoH) who actually take the decisions. This kind of "pushed" implementation (i.e. the implementation decisions is enforced externally from outside the hospital without taking the real needs or inputs from the hospital decision makers into consideration) was frustrating. One of the critical success factors in implementing such a system is “involvement in the implementation period”. This was perceived by one of the decision makers:

> *“Things will never work properly if you buy readymade software and impose it. The involvement of the potential users in selecting the best software is very critical for successful implementation.”* ID002

This common feeling, voiced above in the words of the decision maker, reflected a “non-buy in” attitude. In other words, this “push” implementation which neglected to obtain decision makers’ feedback in the implementation, affected the ensuing commitment negatively. This was very clear in the nurses’ focus group.

> “*Before purchasing the software, we should convince and obtain commitment of all doctors, nurses, radiologists, pharmacists and laboratory staff. If we do this, then we will have greater chance for successful implementation of the EHR*.” FGD002-P14

In the same vein, the Medical Director complained:

> *“Before selecting the software, all users must be involved to decide what specifications meet their needs and expectations, rather than imposing a readymade software.”* ID002

Likewise, in the doctors’ focus group, feelings about the way the EMR had been brought into the hospital were reflected in the following statement:

> *“You cannot purchase a readymade programme and ask the medical staff to adapt their work to it. It should be the opposite. The software must be adapted to the workflow of the medical staff.”* FGD001-P6

Furthermore, the MoH’s unwillingness or inability to listen to staff regarding the implementation phase played a critical role in the employees’ involvement. This was explained by a nursing director as follows:

> *“It is very simple. Talk to the users, listen to them, get their opinions and understand their needs. I think the involvement of users, the infrastructure and the training needs should be addressed properly before you talk about implementation.”* ID002

Indeed, ignoring staff in plans to select and implement the system affected their involvement and enthusiasm toward the system significantly, as they did not feel they "owned" the system.

> *"When people participate in the selection of the right software, they feel they own the programme. This is a good reason for them to implement the system: they have participated in its selection."* FGD002-P15

One of the desires of the interviewees from both the focus groups and interviews with directors was the involvement of users when selecting the type of software to adopt:

> "*Simply involve the users to decide about the required specifications and features of the software and all other issues.*" ID002.

Therefore, it was widely perceived that the staff had not been involved in the implementation phase of the system, as illustrated in Figure 37. This lack of involvement affected the staff significantly, at least from the perspective of involvement in the post-implementation phase.

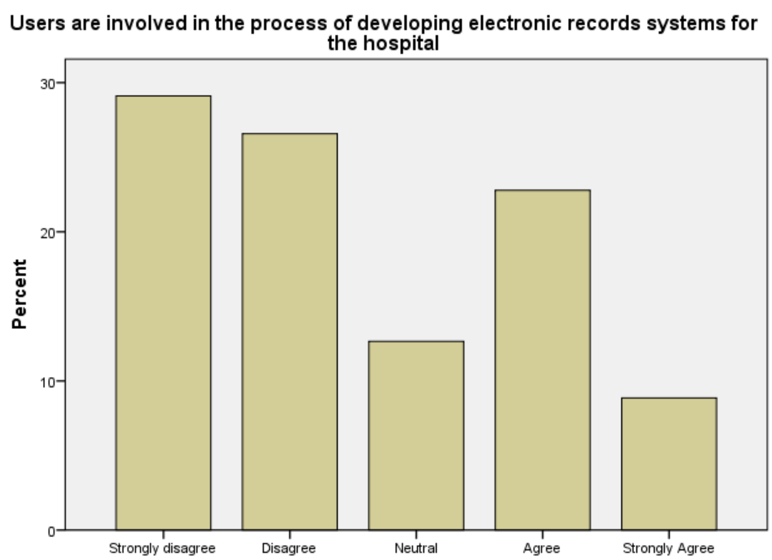


Figure 37: Users are involved in the process of developing the EMR system for the hospital

To summarise, as illustrated in Table 28, the lack of involvement in the implementation came mainly from implementing the system via higher authority/superior staff without involving the users. The "push" implementation approach adopted by MoH in this case left the decision makers disappointed. This in turn led to resistance to further implementation as users felt uninvolved in the post-implementation period and thought that the system did not fit with their needs.

Table 28: Involvement in the implementation phase: sub-themes

Theme	Sub-theme
Involvement in the implementation phase	Push implementation
	Perception of the fit between the system and the organization
	Feeling that this was a system imposed from above
	Involvement in the post-implementation

5.4.2.2.2.2 Training

Based on a frequency word count of the interviews and focus group transcripts, the word "training" gained the highest word frequency amongst all the motivational and de-motivational factors. This indicates that training was a major issue, at least from the perspective of the interviewees. The quantitative data also support the significance of training in the implementation as more than 45% of the respondents believed that they had not received adequate training, as illustrated in Figure 38.

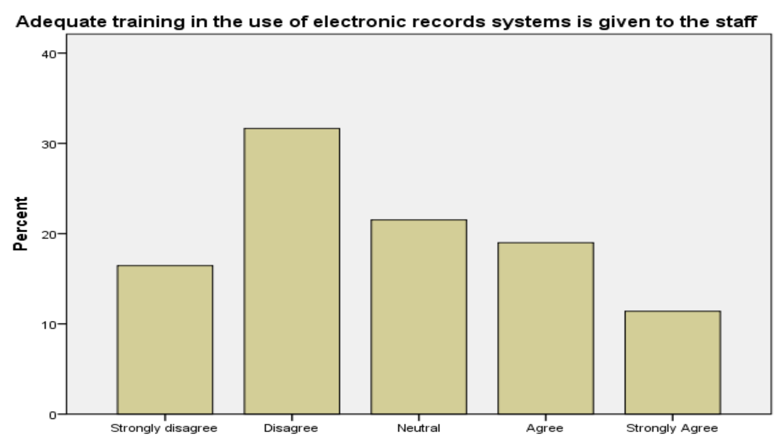


Figure 38: Adequate training in the use of EMR is given to the staff

Training devoted to users is not the same in all departments

Not all departments had received the same level of training. On one hand, users in the radiology department felt they had received sufficient training and this department, which had devoted resources and considerable effort to train its employees, was very satisfied with the system. The Director of X-rays showed that investment in training on the system in his department was significant when he said:

> *"Regarding the PACS system, all heads of departments were trained.* ***Some*** *of the staff* ***was sent abroad for training****. They were trained in Holland. There is a* ***well-equipped training Centre*** *for the PACS and* ***all doctors and nurses were trained****. In* ***13 months*** *period we managed to train them all."* ID005

On the other hand, other departments received little training in the system and these departments reported lower levels of satisfaction than their well-trained peers. Indeed, there was no systematic training for the users, as noted by a nurse in the focus group:

> *"They don't have a training programme for nurses. They leave them to teach themselves by themselves."* FGD002-P-14

Insufficient training in many departments

Participants in the doctors' focus group held the same position towards the training and its insufficiency was a main theme which emerged during the talk. The comments of doctors in the focus group and decision makers regarding training ranged from *"**no proper training**"* (in a nursing focus group (FGD002-P12)) to the inability of staff to become qualified users by simply taking one day's training. This suggests the recommendation that the current resistance to the system could be resolved by training the users.

> *"Train people for* ***one day*** *on such a huge programme."* FGD001-P7

According to another doctor in the same focus group:

> *"I would raise the problem of* **training**. *They trained* ***me for one day*** *on a very big and complex system. How they expect me to use the software in the right way?"* FGD001-P4

Another doctor in this focus group said that the training provided was felt to be ineffective due to its fast pace and complexity.

> *"There were few training sessions carried out, but I don't think they were effective in raising the awareness of the medical staff regarding the use of EMR. Computer training and education for the medical staff is very challenging."* FGD001-P1

Additionally, other doctors complained that training should not just be given on the usage of the system; it should also cover the possible problems that might arise from its use.

> *"We do need the programme, but we need adequate training and solutions for all the deficiencies and defects in the current system."* FGD001-P7

Training could be an effective tool for managing users' resistance to the EMR

Training is not only required if the system is to be better used but also for motivating users to use the system and decrease resistance to it. This sort of training system is aimed at avoiding resistance amongst the staff with respect to the adoption of a new system. Change is not looked upon favourably and an intense training session could alter this view. As a Medical Director commented, training on the EMR would help users to know the benefits of the EMR so that they would be encouraged to use it:

> *"The main support was the training of the staff. Another thing was educating them about the potential benefits of the EMR system. You can say there was some sort of encouragement for the staff to implement the EMR system."* ID002

Supporting to this point of view, a doctor in the focus group stated that the resistance to the system did not come from the system in itself. Instead, the problem lay in their inability to use it and other technical problems they faced with the system:

> *"My colleagues are talking about training. This doesn't mean we are against the programme. We do need the programme but we need adequate training and solution for all the deficiencies and defects in the current system."* FGD001-P7

As summarised in Table 29, adequate training was reflected in terms of the adequacy of the resources devoted to training, particularly with regard to time and effort. Resources devoted to training affected the training's effectiveness and inadequacy in this regard counteracted the ability to standardise/customise the training in different MoH hospitals.

Table 29: Themes of inadequate training

Theme	Sub-themes
Inadequate training	Training is not the same in all departments
	Training leads to user satisfaction with the system
	Training is insufficient in many departments
	Training is a tool for managing resistance against EMR

5.4.2.2.2.3 Complexity and difficulty of use

There appeared to be problems with the complexity of the system: i.e., the standardisation of the terms, interfaces and data. Based on the questionnaire, most respondents believed the complexity of the system was most likely to hinder further implementation. One interviewed senior physician described one aspect of this complexity:

> "*I think one of the problems is the absence of a standardized abbreviation list. You know each unit is using its own abbreviation.*" FGD002-P16

Another noted the non-standardisation of interfaces when he said:

> *"These systems are difficult. Some of these systems are complicated (like ours) and some are friendlier to users. Frankly, different interfaces of the system are very confusing to us."* FGD001-P1

A third aspect of the complexity of the system was the standardisation of data among different systems. It should also be considered that although there were generally positive attitudes toward the system in terms of convenience (as explained earlier in the motivations section), there were a few who did not generally use technology in their daily lives and they felt the system was difficult to use, as noted below:

> "*I really find the system very complicated and confusing. My knowledge and skills on computers is very little because I seldom use it in my daily work. I am not alone. Some of my colleagues are also semi-illiterate users of computers.*" FGD001-P1

Overall, as illustrated in Table 30, the complexity of the system, in terms of the non-standardisation of the abbreviations, interfaces and data, appeared to be one of the reasons for the resistance to the system. It was felt that the system was burdensome to use for those who did not usually use technology in their daily lives.

Table 30: Complex and difficult to use sub-themes

Theme	**Sub-themes**
Complex and difficult to use	Complexity emerged from non-standardisation of abbreviations
	Complexity emerged from non-standardisation of interfaces
	Perception of difficulty for some users who are not familiar with technology

5.5 Conclusion

Many factors appeared to motivate employees to implement the system further and many were eager to escape the old manual system. However, obstacles in the current situation of the hospital appeared to outweigh these motivational factors. It is clear that there are three statuses of EMR components: having been installed, being used and no longer in use. The hospital had been encouraged to use the new system as it enabled them to escape the plethora of problems posed by the manual system. Paper-based records were bulky to store and move around, they required much space for their storage and needed separate staff to manage them. These issues were costly to the hospital in terms of time and money. The pros concerning EMR also weighed in the decision as the flow of information was improved, errors that could possible harm patients were greatly reduced, and there was a significant improvement in patient care and safety.

With regard to obstacles to implementation (the demotivational factors): the ability of the system to enable users to use it effectively and efficiently appeared to be constrained by the ability of the IT infrastructure, in terms of a lack of powerful computers and well-integrated networks. A member of the Board of Directors blamed the government for this, as follows:

> *"And the concerns still exist. We do not have the right infrastructure. They (ministry of health people) just want to implement the system without establishing a good infrastructure."* ID002

The figures and quotations given in this study showed that "people" are interested and they want and expect more, especially from the successful components of the system (pharmacy, lab and radiology). Nevertheless, the lack of training, consultation and involvement in some departments made the use of the components fall below expectations. Furthermore, the irresponsiveness of top management to the users' needs made the system an obstacle for many users in different departments. All of this has led to many complaints being made against the system. Besides the disinterest of the top management toward the EMR, these complaints have made the top management decide to stop using various EMR components that were already installed and applied; this caused the hospital to descend from a level 4 implementation to a level 1.

Chapter Six: Case Study Two

6.1 Introduction

This chapter addresses the motivating and demotivating factors that affected the level of implementation of EMR in the second hospital. According to the HIMSS analytic model, this case achieved an implementation of EMR at level one. However, while case one moved to level three but then regressed to level one, this case (Case Study Two) had not yet attempted to achieve level two.

A mixed approach methodology was employed to gain an in-depth understanding of the motivating and demotivating factors concerned in furthering or regressing in the implementation of EMR, as well as to investigate the attitudes and perceptions of employees and decision makers towards using EMR.

This chapter starts by considering the context of case Two in terms of its size, functions, IT infrastructure, and level of EMR implementation. Afterwards, as illustrated in Figure 39 the data collection methods used are explained. Finally, before presenting the conclusion of the chapter, quantitative and qualitative analyses and findings are presented.

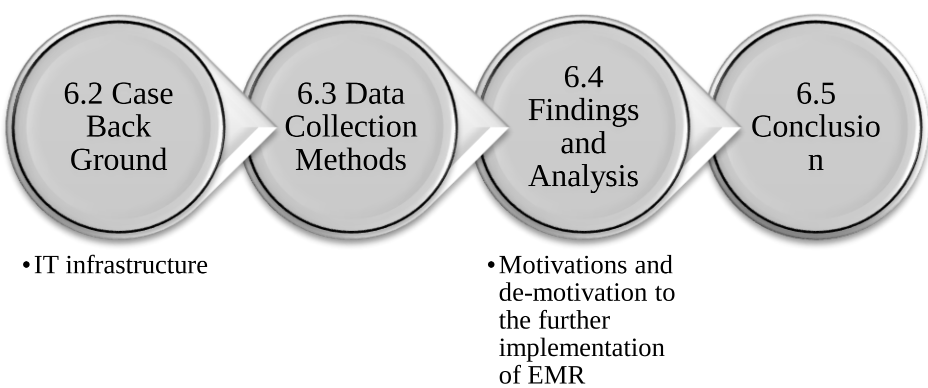


Figure 39: Structure of Chapter 6

6.2 Case Background

This case concerns one of the leading hospitals in the province of Saudi Arabia that is located in the east of the country. The hospital was established in the 1980s by the Ministry of Health as a secondary care facility. Additionally, it provides a wide range of almost all medical and surgical specialties in addition to support service departments such as an emergency department, laboratories, and audiology and radiology facilities.

Throughout the years, this hospital has included new health services to achieve enhanced patient care; these include home care services, day care and day surgery services, and specialised centers for thalassemia and sickle cell disease. There is a patient affairs department and bed management services are provided.

For further quality improvement in terms of patient and staff safety, a quality department, a safety and security department, and an infection control department have also been introduced. These departments work hard in order consistently to reduce the risks that may affect patients and staff, and to provide a safe environment. Thus, the hospital in this case study looks to achieve the highest standards of care and to gain regional and international accreditation. Recently, in 2011, it gained regional quality accreditation from the Central Board for Accreditation of Healthcare Institutions (CBAHI).

6.2.1 IT infrastructure in case two

Recently, the Ministry of Health (MoH) in Saudi Arabia has changed the title of its IT departments. Such departments now come under the umbrella of "e-health" with the Ministry of Health seeking to automate its health services and to integrate all its HE systems by creating the vision of a national Electronic Health Records (EHR) system; this will integrate and share information across the nation's healthcare provision. The MoH is undertaking this in order to improve the overall quality of healthcare and patient safety in the Kingdom, and to lower healthcare costs while developing more effective health policies.

This hospital, as with the first case, uses the three core integrated electronic modules of EMR: laboratory, radiology and pharmacy. However, the radiology module, unlike other modules in this case and in other cases, has been developed internally using internal resources (i.e. for funding, programs and analysts).

6.2.2 Lab system (fully automated)

This is an outsourced Windows-Based Electronic System purchased by central government. The main aim of it is to serve the administrative functions of the Laboratory and Pathology Departments, such as maintaining records, sharing information, and storing and retrieving files. This system provides its services 24 hours a day and 7 days a week for the following sections: Chemistry (including hormonal assessment), Serology (for infective agents and immunologic disorders), Microscopy (for the examination of urine, stools, semen and body fluids), and the Histopathology and Cytology sections. All sections maintain good and cooperative relationships with other laboratories in all neighboring hospitals. Tests which are unavailable are sent (by special agreement) to referral laboratories such as Dammam Regional Laboratory, King Faisal Specialist Hospital and to other hospitals overseas if necessary.

6.2.3 Pharmacy (fully automated)

This is also an outsourced Windows-Based Electronic System purchased by central government; it is integrated with other systems and aids the pharmacy in carrying out its operations which include providing pharmaceutical services for all patients' departments, including the outpatient and emergency departments, by dispensing inpatient and outpatient orders, and emergency prescriptions. Moreover, it enables the pharmacy to maintain records of pharmaceutical inventory updated 24 hours a day.

6.2.4 Radiology (fully automated)

Unlike the other outsourced electronic systems in the hospital (i.e., the laboratory and pharmacy systems), the radiology web-based system has been (with some minor problems) internally designed, developed and integrated with the other modules. The radiology department provides diagnostic imaging services which include x-rays, barium studies, ultrasound, spiral computerised tomography, CT scans, whole body and brain magnetic resonance imaging (MRI), angiography, myelography, interventional radiology, intra-operative procedures, whole body bone density scans, mammography and Doppler examinations.

Unlike the PACS system (Picture Archiving and Communication), which provides high resolution images that can be used in diagnoses, this system does not provide such a level of resolution and is therefore not effective in diagnosis. Therefore, the internally developed communication system is less effective and efficient than PACS. The hospital administration voiced concerns that the software would affect the speed and volume of information sharing within the hospital network because this software is not integrated with the EMR. However, these concerns diminished once the module was implemented. Although the system faced a number of financial difficulties in the beginning as it was internally funded, because of its success, the government finally sponsored the project by purchasing servers for the hospital as a reward which had previously been unaffordable.

6.3 Data Collection Methods

This case study adopted a mixed-method research approach, as can be seen in Figure 40. As explained in detail in Chapter 4, four data collection tools were used: document analysis, questionnaires, interviews and focus groups.

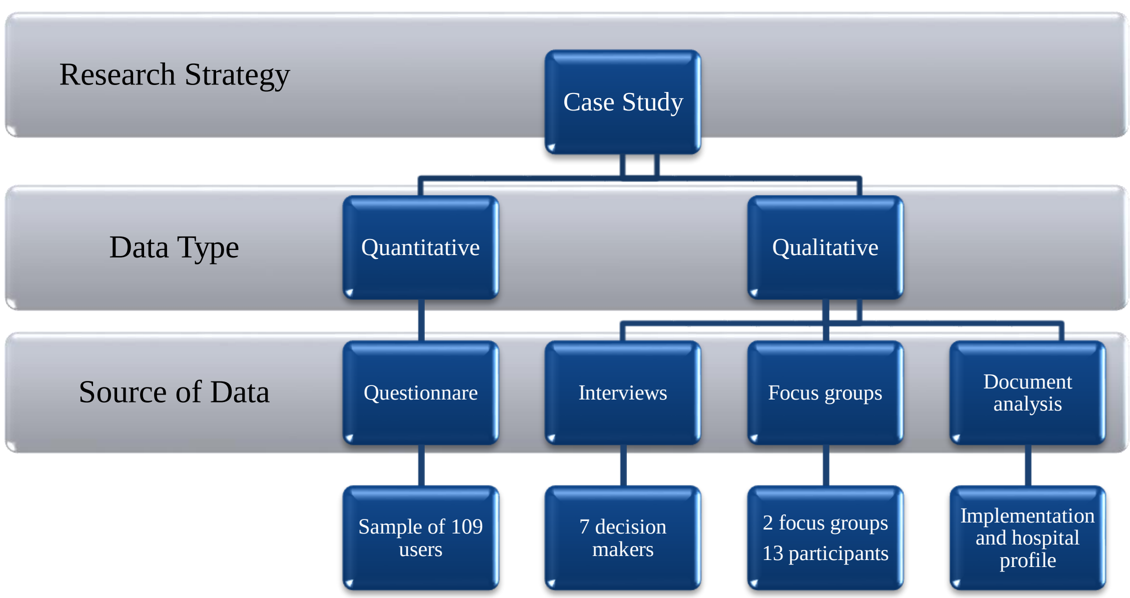


Figure 40: Data collection methods in the second case study

6.3.1 Document Analysis

A range of documents were studied and analysed while undertaking this case study. Documents used included those on the hospital's website, hospital notice boards, implementation documents, document standards, and quality standards requirements.

6.3.2 Questionnaire

The population of this case study consisted of all the users within hospital 2; this consisted of 1600 staff members, including 327 doctors and 570 nurses. 120 questionnaires were distributed randomly and 108 questionnaires were returned, a return rate of 90%. Respondents came from all departments. Differences in demographic and computer literacy backgrounds were all represented in approximate proportion to the hospital's population by employing random sampling. Roughly, two thirds of the *respondents were medical staff as 31% and 36% of respondents were physicians and* nurses respectively (see Figure 41). This is because the critical users of electronic medical systems are the medical users.

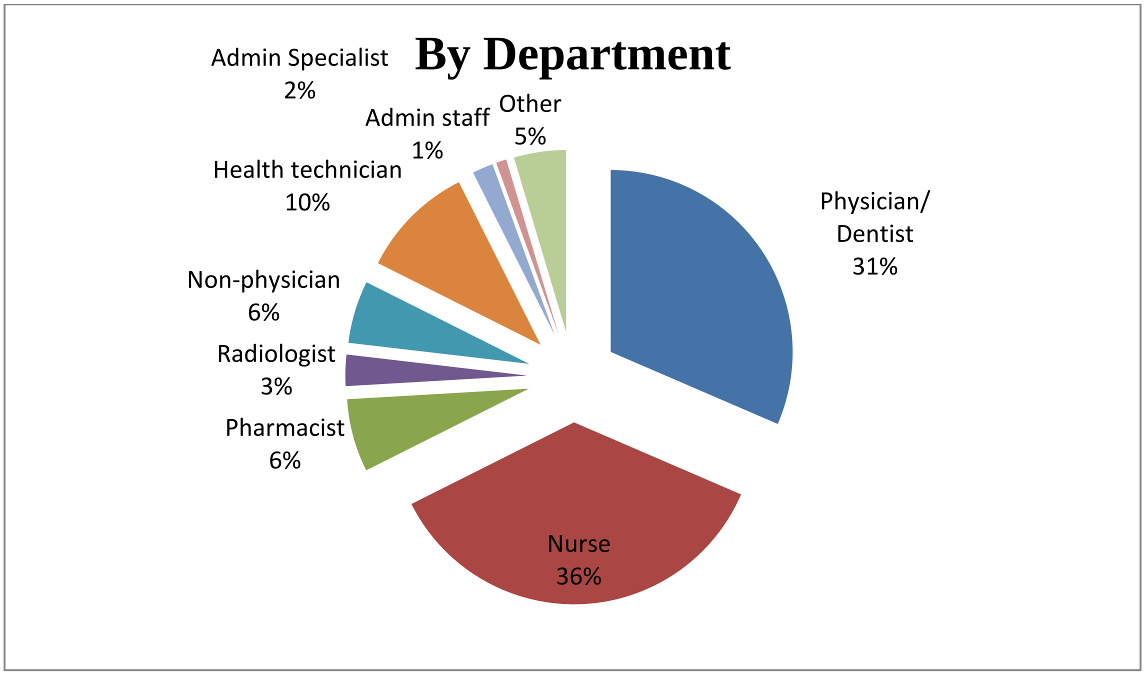


Figure 41: Respondents' profiles by department

6.3.3 Interviews

Seven individual interviews were carried out with decision makers, all of whom were seniors with experience of more than 11 years. As Table 31 shows, the interviews took on average 43 minutes.

Table 31: Interviewees' profiles

Code Name	Interviewee's Position	Time	Years of Experience	Age Bracket
IQ001	Chief of Radiology	45	26 y	50-60
IQ002	Chief of Pharmacy	42	25y	50-60
IQ003	Chief of Medical Records	45	22y	40-50
IQ004	Chief Medical Director	43	16y	40-50
IQ005	Chief of IT	42	18 y	30-40
IQ006	Chief of Nursing	40	12 y	30-40
IQ007	Chief of Quality	42	11 y	30-40

6.3.4 Focus Group

In addition, two focus group meetings for doctors and nurses were carried out. The focus groups consisted of 16 participants, with eight doctors and eight nurses in each group. Both focus groups took on average the same length of time of roughly an hour and 40 minutes. The ages and years of experience of doctors were significantly higher than those of the nurse participants since most of nurses were new staff; this is illustrated in both Table 32 and Table 33.

Table 32: Profiles of participants in the doctors' focus group

Code Name	Interviewee's Position	Duration1	Years of Experience	Age Bracket
FGQ001		1:45		
P17	Medical Director		18	40-50
P18	Chief of ER		10	30-40
P19	Chief of Obs. & Gyn.		20	40-50
P20	Chief of Internal Medicine		20	40-50
P21	Chief of Surgery		30	50-60
P22	Chief of Pediatrics		30	50-60

Table 33: Profiles of participants in the nurses' focus group

Code Name	Interviewee's Position	Duration	Years of Experience	Age Bracket
FGQ002		1:40		
P23	MMW Head Nurse		8	20-30
P24	FMW Head Nurse		10	20-30
P25	FSW Head Nurse		8	20-30
P206	MSW Head Nurse		9	20-30
P27	PW Head Nurse		20	30-40
P28	Obs. & Gyn. Head Nurse		8	20-30
P 29	ER Head Nurse		15	30-40

6.4 Motivating and de-motivating factors regarding further EMR implementation

Generally speaking, attitudes towards the system were positive. Quantitative indicators supported this argument since more than 50% believed that the system was "wonderful", as illustrated in Figure 42; only about 30% disagreed. Indeed, although positive attitudes towards the system were above average (an average of 3.4 on a scale of five), a significant proportion of respondents also had negative feelings about the system. The qualitative analysis offers a more in-depth understanding of this phenomenon.

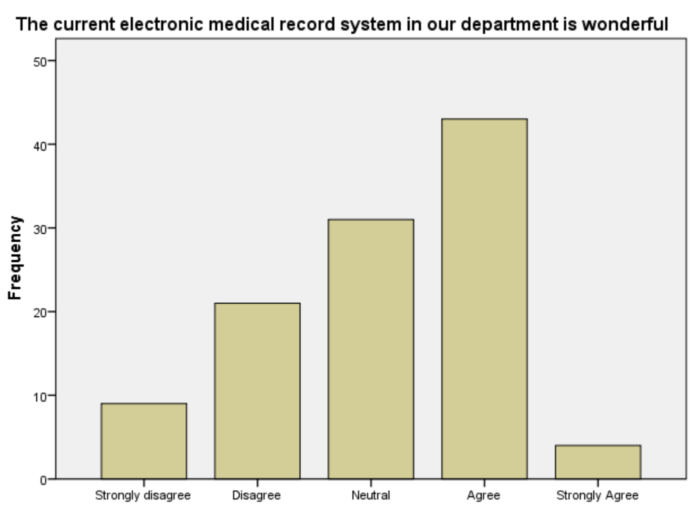


Figure 42: The EMR system in our department is wonderful

After analysing the interviews in this case, it was found that this attitude was positive, not only because (as illustrated in Figure 43) EMR was considered by users as a way of escaping from the problems of the manual system, but also because there was a strong belief that EMR enhanced the organisation's work effectively and efficiently.

> *"The EMR provides many benefits to the hospital. These include fast patient and information flow, easy and timely access to patients' records, increasing productivity, decreasing cost, minimizing wait times, and linking the hospital to the primary health care centers. Not all these benefits would be possible with paper-based medical."* IQ006

However, those problems that limited their desire to further the implementation were technical IT and human challenges: these included the administrative ability to customise the system to fit its processes and financial problems.

> *"It's a great positive shift, but this doesn't mean all things are going smoothly. There are many challenges*." FG001-P22

Figure 43: Motivations and de-motivations for further EMR implementation

6.4.1 Motivation for further implementation

There were three main motivations for further implementation: positive attitudes toward the system, escaping from the manual system, and perceptions of the current benefits.

6.4.1.1 Positive attitudes towards the system

Users felt that the job was more interesting and involved, with less than 5% of the respondents disagreeing that the system did not enhance the quality of their work. According to the responses shown in Table 34, all questions concerning attitudes scored, on average, more than 3.0 with negative skewness.

Table 34: Attitudes toward the EMR

Item	Average	STDError	Skewness
The current EMR system in our department is satisfying	3.11	0.10	-0.48
The current EMR system in our department is wonderful	3.43	0.10	-0.68

This is an important indicator that there was a very positive attitude towards the EMR which is encouraging in terms of implementing the system further. Qualitatively, many quotations indicated a great deal of enthusiasm for the system.

> *"The electronic health record is a good idea and will benefit our hospitals if we solve all problems and find innovative solutions for the challenges that hinder its success."* IQ006

Indeed, one of the decision makers expressed his support as he believed that EMR should be the minimum standard in Saudi hospitals.

> *"I wish to see all EMR systems in the Kingdom are standardized and integrated."* IQ003

Indeed, as illustrated in the following sections, there were clear reasons for this positive attitude, such as perceptions of the benefits of the system, increases in the productivity of employees, and a feeling that the system overcame the problems of manual work.

6.4.1.2 Escaping from the manual system

The positive attitude concerning the system did not come from nowhere. Indeed, the quantitative indicators in Table 35 show a strongly significant tendency to accept and prefer the current state of affairs rather than the former manual way of working. All indicators show negative skewness which means there is an unsymmetrical curve towards positive attitudes with regard to the current situation. Indeed, the average score of 4.56 (on a 5-scale measure) for the question that asked whether they preferred the current situation (using electronic records) to the previous manual system was significantly high. This encouraged the researcher to investigate the phenomenon more in-depth.

Table 35: Improvement in working conditions after implementing EMR

Item	Average	Std Error	Skewness
Using electronic medical record systems in the hospital is better than using manual records	4.54	0.07	-2.05
Using electronic medical record systems in the hospital is more helpful	4.53	0.06	-1.89
If I had to choose between the electronic medical records and the manual ones, I would choose the electronic	4.56	0.06	-2.04

After investigating this phenomenon, certain reasons were found for users' perceptions after implementing the system (see Figure 44): these concerned the cost of operations and problems with clinical decision making. Indeed, users were not aware of these benefits before implementing the system as it was implemented by the government without involving them at the beginning.

> *"……... Nobody told us anything or asked our opinion. The EMR in our hospital is the idea of the Ministry of Health (MoH)."* IQ002

The cost of operations was huge before implementing EMR since such costs were largely associated with handling and dealing with paper work. Such manual processes were also a headache for users, wasting lots of time and effort. Furthermore, decision-making processes were also negatively affected. The decision-making process carried with it many errors due to the unavailability of data and poor communication between departments.

> *"Medical records were fragmented, scattered in many areas, unavailable in a timely manner and difficult to access. Other problems included: loss of laboratory reports, X-ray films, waste of time and effort."* IQ007

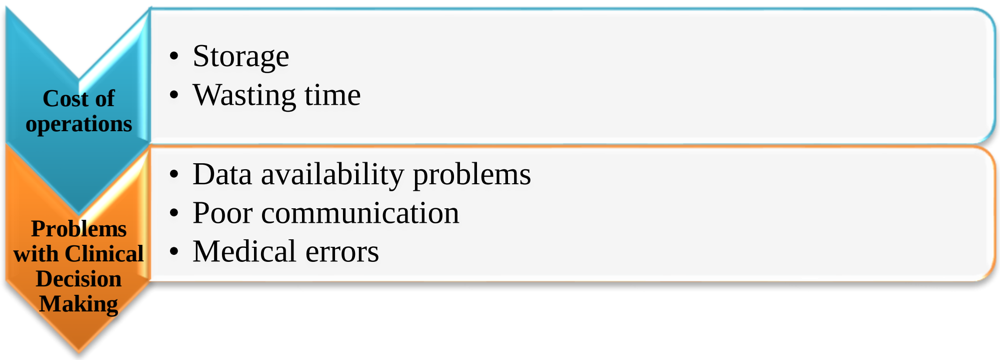


Figure 44: Escaping the manual system: themes and sub-themes

6.4.1.2.1 Cost of operations

The success of healthcare organisations in reaching their medical-related and business goals depends on the quality of the services they offer. Hence, quality is one of the most important concerns of healthcare organisations that motivates them to use computerised systems. As illustrated in Figure 45, the high cost of manual operations results partly from the large spaces needed for storage, the health care provider's time is often wasted, and efforts are frequently duplicated.

> *"All these problems used to cause risk to patients, waste time, extra work load to the staff and increased costs."* IQ002

Figure 45: High cost of operations with manual working

6.4.1.2.1.1 Storage

Departments such as radiology and medical records were most negatively affected by manual working which generated a significant part of the cost of operating these two departments. Furthermore, storage costs increased exponentially as the number of patient's increased over time.

> *"The cost of developing, processing and maintenance of X-films was continuously increasing."* IQ001

Bulky storage

As mentioned earlier, the volume of past and present patients' records became tiresome to handle and also created difficulties in terms of management. As can be seen in Figure 46, the amount of documentation was too great to be filtered or used; there was no room to store them since the shelves were all full.

Figure 46: Documents before implementing the EMR

needed for filing and retrieving files and documents.

> *"We faced many problems regarding the huge size of the X-ray films, the big space needed to keep them and high number of staff needed for filing or retrieving."* IQ001

Naturally, as the space requirements increased, so did the costs associated with them, and this burdened the hospital further.

> *"Loss of laboratory reports, accumulation of huge numbers of records, increased work load, increased cost and shortage of space and filing cabinets*." IQ003

The bulk of the cost went into the maintenance and transportation of the Paper-Based Records while staff needed to be hired to cater for this specific purpose.

> *"Before the system we used to have a full time worker just to bring down inpatients' records from the units."* IQ003

Not only was a *"high number of staff needed for filing or retrieving" (*IQ001*)* but this duty also fell on other employees which cost them their time. Moreover, hiring new employees for this specific purpose was not a pragmatic or permanent measure.

> *"…the big number of prescriptions which we have to register manually every day. We write around 11 thousand prescriptions every month which needed 4 full time staff to do the work."* IQ005

On the other hand, after implementing the system, almost all of these problems had diminished, as a Radiology Manager noticed:

> *"Now we can save huge numbers of images in a very small space on the server. The availability of images at all times and places."* IQ001

Large spaces needed

When using a manual system, the need for large spaces is a major concern. In this study, the radiology department faced the greatest challenges in this regard. As the Radiology Director said:

> "*We faced many problems regarding the huge size of the X-ray films, the big space needed to keep them and high number of staff needed for filing of retrieving, as well as loss of X-ray films and reports."* IQ001

This issue also was mentioned by the Medical Director when he said:

> "*Other problems include: loss of laboratory reports, accumulation of huge numbers of records, increased work load, increased cost and shortage of space and filing cabinets.*" IQ004

No central filing area

The need for large spaces led to many problems as no large central space existed in which to maintain all these documents and files. Therefore, in the manual system, records were distributed in different places.

> *"X-ray films were kept in different places in the hospital. I mean, in outpatient clinics, inpatient units and in the radiology department. There was no central filing area for keeping X-ray films."* IQ001

Indeed, this problem emphasised the negative impact of the manual system on the cost of operations by giving the organisation more problems such as the loss of records and increased workloads.

Lost records

It was difficult to keep track of the large volume of records and therefore losing or misplacing them was an inevitable consequence.

> *"The way they used to mount investigation reports in the paper medical record was not effective and many reports were lost during handling the patient's paper medical record."* IQ005

However, it was not clear whether it was sheer volume or a lack of organisation that led to the loss of documents.

> *"There was no central filing area for keeping X-ray films. This is one of the reasons for losing the films and the reports."* IQ001

This was a critical problem as it expressly affected the quality of patient care.

> *"Losing investigation reports was one of the big problems solved now by the EHR. The way they used to mount investigation reports in the paper*

medical record was not effective and many reports were lost during handling the patient's paper medical record.” FG001-P21

In summary, as illustrated in Table 36, storage problems were significant according to directors who recalled the difficulties of the days of manual working. Problems were summarised as the large space needed for the bulky documentation which, in turn, caused another problem: distributing files across different departments. This clearly led to records being lost, as well as increases in the costs of handling them, and increased workloads.

Table 36: Storage problem themes and sub-themes

Theme	Sub-themes
Storage	Bulky to store
	Big spaces needed
	No central filing area for keeping records
	Loss of records

6.4.1.2.1.2 Wasting time

In contrast with manual working, around 60% of the users agreed that the new system was more time-efficient and saved effort. Likewise, Figure 47 shows that more than 60% of the respondents agreed that the EMR system decreased the number of unnecessary medical tests. These two questions spotlighted the importance of EMR in users’ work and could be seen as a motivator to discontinue manual working.

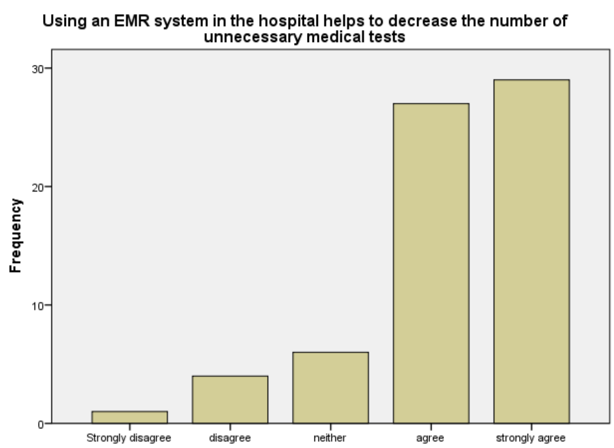


Figure 47: Using an EMR system in the hospital helps to decrease the number of unnecessary medical tests

Indeed, the pharmacy department sometimes panicked when using the manual system as before they implemented the EMR system they had to write 11 thousand prescriptions every month, as the Pharmacy Manager stated:

> "*…the big number of prescriptions which we have to register manually every day. We write around 11 thousand prescriptions every month which needed four full time staff to do the work.*" IQ002

Additionally, from the perspective of the pharmacy department, in order to know the historical medication record of a patient before issuing any medicine, they needed to retrieve the patient's file from the storage area; this was a considerable headache and a waste of time. This is clear from the Pharmacy Director's words:

> *"We used to request inpatients' charts to prepare the medications for inpatients. All these problems used to cause risk to patients, waste of time, extra work load to the staff and increased costs."* IQ002

From another perspective, the radiology department needed a huge number of staff to retrieve and sort reports situated in different places within the hospital.

> *"Medical records were fragmented, scattered in many areas, unavailable in a timely manner and difficult to access. Other problems include: loss of laboratory reports, X-ray films, waste of time and effort.*" IQ007

In brief, as illustrated in Table 37, manual work wasted much valuable staff time as they needed to write one thing many times in different places, thus duplicating efforts. Therefore, manually writing records kept in different places led to problems in terms of the retrieval and handling of such records.

Table 37: Wasting time: themes and sub-themes

Theme	Sub-theme
Wasting time	Writing too many prescriptions
	Retrieving and handling records and reports
	Duplication of efforts

6.4.1.2.2 Problems in clinical decision making

With the manual system, there were many obstacles to effective decision-making. As illustrated in Figure 48, in order for an organisation to have effective decision making, data should be available at the right time and should be reliable (i.e. free of significant errors). Relying on manual handwriting is risky as the handwriting of hospital staff is not uniform and different personnel cannot always read easily what others have written. This significantly affects the level of medical risk. Moreover, the fragmentation of health information across departments in the absence of an effective EMR system led to communication problems and defects across the hospitals.

Figure 48: Obstacles that hinder the effectiveness of clinical decision-making using a manual system

Indeed, this affected the timeliness of the availability of data such as Medical Health Records which in turn led to many problems, such as an inability to determine drug interactions for patients who were receiving medicine. Indeed, this also affected patient risk. However, all these problems were ameliorated by using an EMR system, as noted in the focus group.

> *"Now we build our decisions on more accurate and comprehensive clinical information. As our colleagues said, we used to struggle to access simple basic information with the paper-based medical records*." FGQ001-P22

This argument was widely accepted in the focus group, as another participant in this focus group mentioned:

"I agree with you. Now we build our decisions on more accurate and comprehensive clinical information." FGQ001-P20

Furthermore, this area was addressed many times in interviews with other participants:

"Medications are safer, because we use the system to check any errors or drug to drug reaction." IQ002

Problems in clinical decision-making arose from poor handwriting, the lack of availability of data in a timely manner, and poor communication between departments. These problems were very clear in various departments. For instance, in the pharmacy department, since it is not reasonable to expect patients to know about the history of their illnesses or fully remember the medications prescribed to them, the data entered through the electronic system constituted an advance in this direction. Once only accurate information was given for the medical care of patients, safety was improved since precise details of doses and the dates of those doses could be made available.

"All information about the medications taken by patients is available in the system. This is a very important characteristic." FGQ001-P20

6.4.1.2.2.1 Data availability problems

A lack of availability of data in a timely manner was the first obstacle to making effective decisions at the right time. Indeed, before implementing the EMR, doctors had made many complaints regarding the unavailability of data at the proper time. This was reported by the Quality Manager who said:

"*Doctors suffered much from the non-availability of the films and reports when needed during patient care."* IQ001

This problem of data being unavailable in the manual system was also commented on by the Director of Nursing as this was perceived to be a common problem before implementing EMR.

"*.....unavailability of patients' health records in a timely manner to the medical staff*." IQ006

Before implementing EMR, this problem was noted by the pharmacy department, as well as by doctors' complaints, as this department faced many problems due to the lateness of receiving the files and documents they required.

> *"There was difficulty in accessing the medical history and the diagnosis of the patient upon dispensing of medications."* IQ002

On the contrary, after implementing EMR, this problem was addressed as the Medical Records' Director revealed:

> *"As far as our hospital is concerned, we have seen many benefits since we used the EMR. The main benefits included availability of patient records and X-ray, fast and easy access to patients' information, and accessibility by more than one staff at the same time."* IQ003

Data Access

One of the main reasons for the unavailability of data in a timely manner was the inability to share data across departments in an effective and efficient manner. Indeed, this problem was inherent in the nature of the manual system, as explained previously regarding storage problems. These problems were connected in the mind of the Chairperson of Medical Records.

> *"The first problem was the unavailability of patients' health records when needed by the medical staff. The second one was the difficulty in accessing patients' clinical information."* IQ003

Fragmentation of patient information

Besides the problems inherent in the manual system, such as the inability to share data across departments in zero time, the fragmentation of patient information only exaggerated the problem. The hospital in this case study, as illustrated earlier, faced problems with regard to the storage of records and files in a centralised location. This affected the availability of data for decision makers. For instance, the four "volumes" shown in Figure 49 were separated in different departments but concerned only one patient.

Figure 49: Four volumes for one patient

In qualitative terms, the Quality Manager noted:

> "*Medical records were fragmented, scattered in many areas, unavailable in a timely manner and difficult to access*." IQ007

Indeed, even the single types of data, such as radiology reports, were located in different places, as mentioned by the Radiology Director:

> *"X-ray films were kept in different places in the hospital."* IQ001

Data fragmentation was still a problem, even after the implementation of the system, if the system failed. Such an occurrence reminded users of the black days of the manual system, as shown below.

However, using the EMR managed to overcome this problem, as was stated when participants were asked how far EMR confronted such difficulties:

> *"Very much improved. Before, we used to struggle to access the information. For example if you needed to see a result of an important blood test made a few years ago, you would have to search in many volumes of a patient's paper records. The access to clinical information was very difficult and time consuming. Now you just need to press a button to get all you need. Access to patient's information is very fast now compared to before."* FGQ001- P18

EMR facilitating the availability of data

Although users still had memories of manual working, after implementing the system, data were available anywhere and at any time as required. For instance, the happiness of the Nursing Director was clear when she explained how the EMR system had made things easier and faster.

> *"I can say that there are and many benefits of the EMR. The availability of heath records and information has improved. The access has become easier and faster. Nurses don't need to go to the laboratory to bring the test results. They don't need to take patients' health records to the pharmacy to be reviewed by the pharmacists before dispensing medications for inpatients. Nurses don't need to call the dietary department to report each admission and discharge and type of diet. All these can be done through the system without wasting time on phone calls."* IQ006

In summary, as tabulated in Table 38, data were not available at the right time due to the nature of the manual system as it did not enable users to share/use different data from different departments. This problem was aggravated in the case of the hospital in this study because the data were fragmented as there was no central location for maintaining records.

Table 38: Themes and sub-themes of data availability problems

Themes	Sub-themes
Data availability problem	Data access
	Fragmentation of patient information
	EMR enabling data availability

6.4.1.2.2.2 Poor communications between providers

As illustrated in the section on medical errors, poor handwriting was a major concern in this case as it was perceived to be one of the main factors that negatively affected quality in terms of the level of errors and service time. This was noted by the Quality Control Manager:

“Poor handwriting and poor medical record documentation resulted in poor communication among care providers.” IQ007

On the other hand, after implementing the system, as supported by Figure 50, there was a negative skewness (-0.624 with standard error of 0.293) towards respondents’ belief that improvements in communication had been made across departments when using EMR. Also, the mean of the response was 3.84 with a standard deviation of 1.053; these indicators emphasised the role of EMR in enhancing communications across departments.

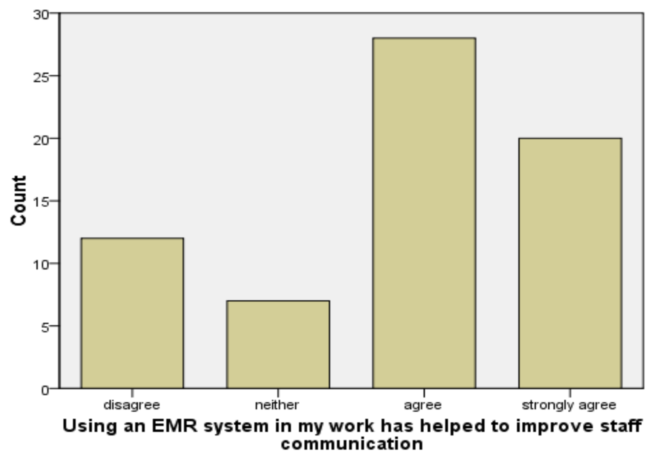


Figure 50: Using an EMR system in my work has helped to improve staff communication

For a more in-depth analysis, the system enhanced communication across different departments in an effective and efficient way as the Radiology Director noted:

“Doctors can consult the radiologist without having to come to the radiology department. Because both of them will be able to see the image on computer at the same time, they can discuss the case without having to meet face to face or leave their places.” IQ001

6.4.1.2.2.3 Medical errors

A strongly positive belief that EMR decreased medical errors was revealed, as illustrated in Figure 51. Fewer than 5% of the respondents disagreed with this whereas 95% of the responses fell between “neither” and “strongly agree”. This had a negative skewness of -.640 with a standard error of .293, indicating significant agreement with a decrease in medical errors.

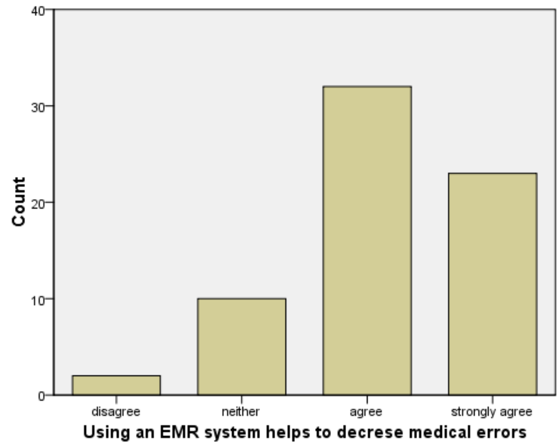


Figure 51: Perceptions regarding reductions in medical errors due to EMR

This motivated the researcher to investigate the medical errors from different perspectives. Most of the interviewed respondents highlighted the problem of handwriting and one of the clearest statements in this regard was made by the Quality Director who said:

> *"Poor handwriting and poor medical record documentation resulted in poor communication among care providers and increased medical errors."* IQ007

In support of this evidence, the Pharmacy Director stated that the main reason for medical errors being made prior to implementing the EMR was "eligible handwriting":

> *"The increasing number of medication errors was due to many causes especially illegible handwriting."* IQ002
>
> Additionally, the Nursing Director, noted:
>
> *"The poor handwriting of some doctors caused many medical errors and put patient safety at risk.*" IQ006

Indeed, the system was perceived as a critical factor in improving patient safety as it decreased the medical errors that arose from poor handwriting. This was pointed out by the Pharmacy Director:

“The main goals are to reduce medication errors and improve patient safety. The technology can help us eliminate the mistakes caused by illegible handwriting and avoid dangerous drug-to-drug interactions.” IQ002

It is sufficient to say that the problem of illegible handwriting seemed to have been overcome by the EMR system.

The problems associated with poor handwriting have disappeared. Another improvement in patient safety.” FGQ001-P17

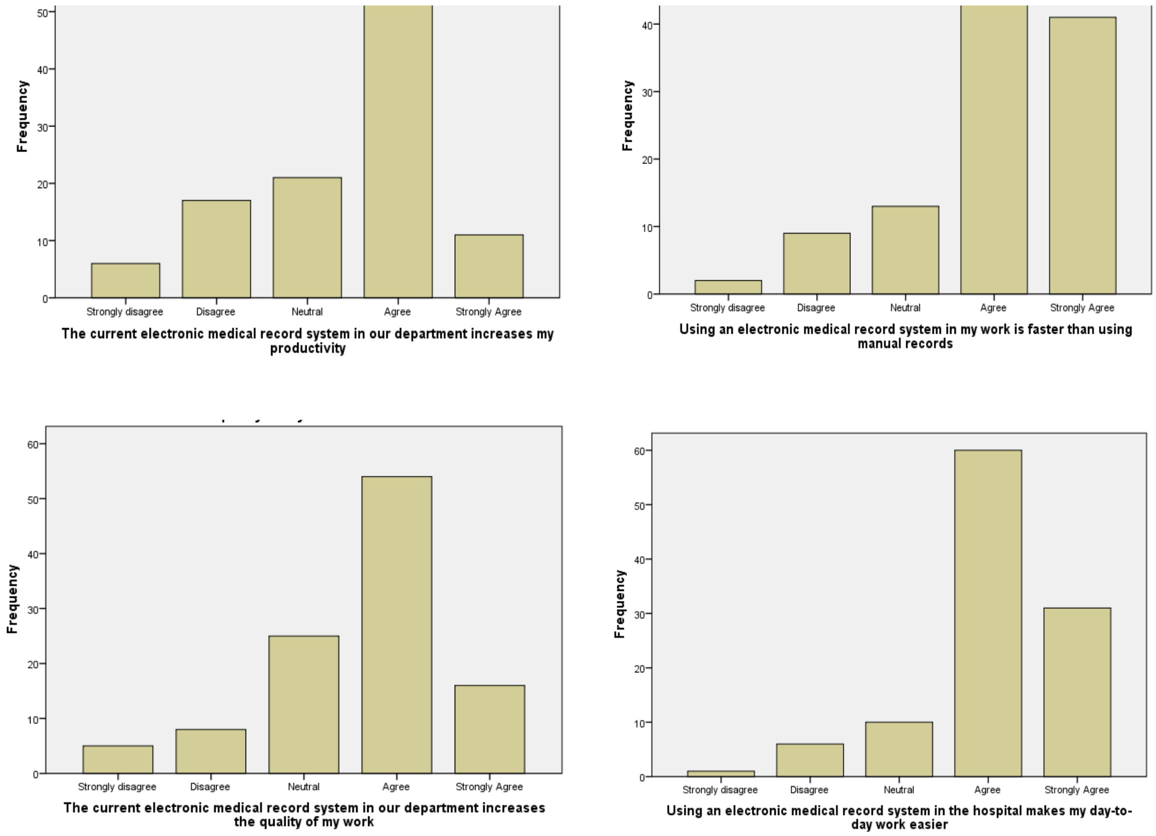
Other medical problems also appeared to have been solved after implementing EMR. Data were now said to be available at the right time, for the right person and with a high level of accuracy.

“The system helped us regarding medications, lab results, radiology images and most importantly, clinical information. I think when you find the information you need, you can make better decisions regarding patient's care.” FGQ001-P20

6.4.1.3 Perceptions of the current benefits

EMR was perceived to benefit radically the jobs of staff, at least in terms of increasing the quality and speed of their work, increasing their productivity, and making their work easier, as illustrated in Figure 52.

Figure 52: The current EMR system in our department increases my productivity quality of my work faster and easier than using manual records



Furthermore, another administrative benefit of the EMR concerned the booking of rooms:

> *"It helped us manage the beds in our units. The system gives reports about the bed situation in the unit. For example, what beds are occupied and what beds are vacant. We do not have to check patient rooms to know that. All information about beds we can see on the computer*." FGQ001-P23

As well as the management of appointments for clinics:

> *"An appointment registration is fast now. There are no waiting times or delays like before. Now we can register the appointment for patients upon discharge. Patients do not need to go to the appointment section to book appointments for outpatient clinics."* FG002-P25

This issue was also noted in doctors focus group:

> *"It helped us in organising and managing the outpatient department. Now we can close the clinics of doctors during their annual vacations. We can now ensure that no new booking will be registered for those doctors until they are back from their vacations. Before the system patients used to come on their appointments to find their doctor on vacation. Now this problem doesn't exist anymore."* FGQ001-P21

Besides these work benefits, a focus of interviewees as a prominent benefit from using the EMR system was patient satisfaction. Patients' satisfaction was a focal interest of decision makers in this case and, in terms of this perspective, as shown in Figure 53, it was found that EMR enhanced patient satisfaction by increasing the quality of patient care. High quality patient care can only be achieved by keeping medical mistakes at a minimum, and by offering privacy and effective processes in terms of timely service delivery at a minimum cost. Achieving these targets is impossible without the existence of effective medical decision-making processes. Finally, effective decision-making cannot happen without the right data being available to the right person at the right time. The capability of the EMR system was shown in this case:

> *"The main goal for keeping medical records is to make the patient's file available for health care providers in a timely manner to ensure continuity of patient care. Ensuring that clinical information is easily accessible by the medical staff at any time is an aim. Medical staff needs patient data for assessing or treating them. The EMR can facilitate achieving these goals by advances in information technology."* IQ004

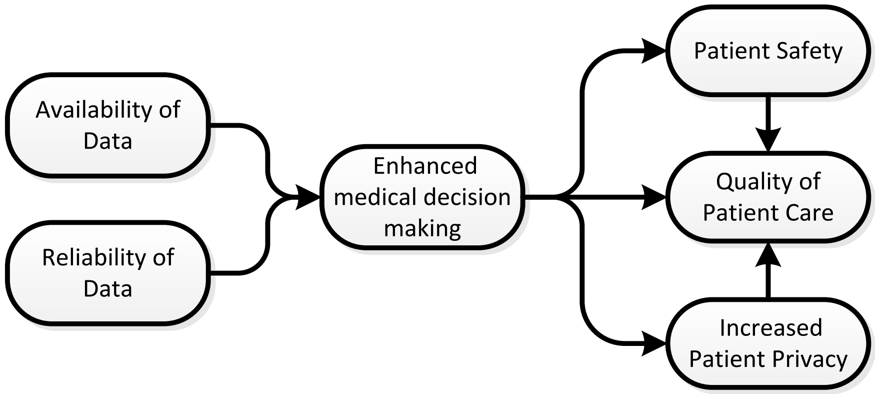


Figure 53: Perceptions of the current benefits of EMR

6.4.1.3.1 Increased effectiveness of decision-making

While fearing problems when using a manual system, EMR managed to overcome all of these problems, allowing staff to focus more on their jobs without being distracted with administrative work. Besides, EMR offered staff enhanced decision making owing to the availability of reliable data at the right time. Furthermore, EMR has intelligent systems that enhance decision-making radically. Doctors' focus group noted:

> *"The system gives you an alert when there is drug to drug interaction. This is also good for patient safety."* FGQ001- P21

Therefore, pharmacists did not now need to worry about the design of medicine intakes as the EMR revealed interactions automatically. This affected the quality of patient care significantly since medical errors in this regard were radically decreased.

In the same vein, doctors' mistakes in terms of written doses were discovered and corrected; this also decreased the number of medical errors.

> *"We can correct mistakes in the dose of narcotics if the physician writes a wrong dose. The system helps us to select the right dose and our correction is generally accepted by the pharmacy."* FGQ002-P29

Likewise, significant medical decision-making benefits were clearly perceived by the Radiology Director as the EMR system spotted human mistakes before anything happened. For example, the system could ensure that a female patient was not pregnant before an X-ray was taken.

"If you request X-ray for a female patient, the system will give you a reminder to check and ensure that patient is not pregnant before you go on with the X-ray." FGQ001- P17

All of these medical errors that could be avoided by using EMR encouraged users to use the system and to appreciate its benefits. Enhanced decision making not only meant decreasing medical errors but also enhanced the allocation and use of resources:

"I agree with you. It helped organise the outpatient department. Based on information from the system we can open new clinics, increase or decrease the number of clinics in any specialty or sub-specialty." FGQ001- P19

In brief, as illustrated in Table 39, enhanced decision-making was one of the most important benefits widely perceived by users. Effectiveness, in the mind of the respondents, decreased medical errors and improved the allocation of resources.

Table 39: Enhanced effectiveness of decision-making: themes and sub-themes

Theme	Sub-theme
Enhanced Decision Making	Decreased medical errors
	Enhanced allocation of resources

6.4.1.3.2 Increasing patient safety

Patient safety is a critical issue for hospital services and the EMR system is perceived widely to enhance this. As explained by the Medical Director, this was one of the main motivations for implementing EMR.

"The motivation for EMR is always improving the quality and safety of patient care." IQ004

As the Quality Director mentioned, EMR enabled the hospital to share data more effectively and efficiently so that responsiveness to the customer was increased as the processes became more efficient and faster.

"The EMR has brought good improvement in the quality and patient safety. The flow of patients and information is faster and more efficient. Access to information is faster and easier. Waits for medical records, lab reports and X-ray films have been significantly decreased. I think all these improvements will lead to increased productivity and decreased defects." IQ007

From another angle, the system was widely accepted, as discussed by a member of the medical focus group:

"I think the electronic system is very safe compared to the paper-based. I mentioned before that the system shows you who accessed the patient's file and at what time and date and what action he or she has taken. I mean especially medications and diagnostic reports." FG001-P19

Furthermore, from the perspective of the pharmacy department, electronic prescriptions saved a lot of time and effort, whilst also enhancing medication safety.

"The Electronic Prescription saves a lot of money through proper medication management, medication safety and general patient safety." IQ002

As discussed earlier in the subsection on data availability, EMR enabled data to be shared across hospital departments at the right time which enhanced radically the quality of decisions. Consequently, it enabled effective coordination between different departments, all of which finally led to improved continuity of patient care.

"EMR is a new technology that can improve quality and patient safety as well as ensuring coordination and continuity of patient care." IQ007

6.4.1.3.3 Increased patient privacy

In quantitative terms, as shown in Figure 54, none of the respondents believed that EMR decreased the patients' privacy as this question received an average score of 3.8 and a standard deviation 0.67 (skewness -0.401). This indicates that there was a very strong belief that EMR enhanced patients' privacy. In manual working, medical reports were kept physically with different unauthorised people in different departments. However, with EMR, only authorised persons were eligible to use the system and only when necessary.

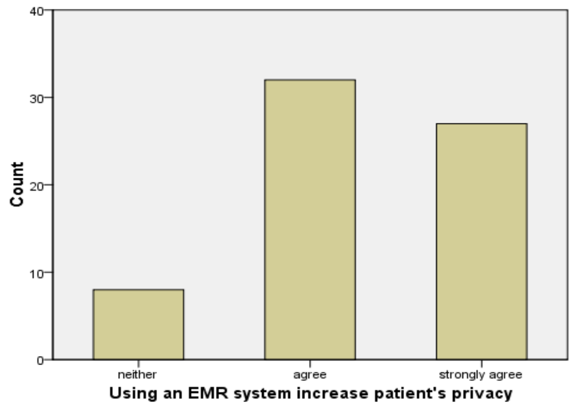


Figure 54: Using EMR system increase patients' privacy

A key point in increasing privacy was the "log file" as this detailed who accessed which data and when. Thus, unauthorised access to patient data was controlled:

> *"As mentioned before, the system shows the identity of all those who accessed the patient's information with date and time. If the doctor is not involved in the treatment of the patient, you can ask him or her why he or she accessed the patient's file at this date and time. I think the electronic is more safe and secured than the paper-based."* FGQ001-P17

Unauthorised access to information

Regardless of this strict management system, as explained above, which spotted any unauthorised access to patients' data, a major concern was voiced by the nursing group: this was the use of others' access information (i.e. password and username):

> *"Safety and confidentiality become a problem if doctors and nurses do not protect their usernames and passwords."* FGQ001-P19

Secured backup

A Director surprisingly expressed the view that such concerns did not have much impact on privacy; he was more concerned about the lack of a secure backup system:

> *"I think both EMR and PBMR are the same regarding the concerns about safety, security and confidentiality. There is no difference between the two in our concerns about these issues. Those who can access the paper record can also access the electronic. I think the new risk brought with the EHR is that we are afraid that all information will be lost from the system. Consider this in the light of a poor backup system or supporting paper records. This is my main concern, sudden loss of all clinical information."* FGQ001-P17

To sum up, as illustrated in Table 40, users were satisfied with the EMR system as it enhanced patients' privacy. Nevertheless, there were two weaknesses that could negatively affect this perceived benefit. First, staff should protect their access details as they could be used to invade patients' privacy. Second, back-up should be secured in a way that could not be easily accessed by an unauthorised party.

Table 40: Patient privacy: themes and sub-themes

Theme	Sub-theme
Patient Privacy	Increased patient privacy with conditions
	Only authorised use of others' access details
	Secure back-up

Increased quality of patient of care

Roughly, all respondents believed that EMR implementation enhanced the quality of patient care, as illustrated in Figure 55, mean 4.21, standard deviation 0.78 and skewness. Quality health care is easily defined as doing the right thing (getting the health care services needed), at the right time (when needed), in the right way (using the appropriate test or procedure), to achieve the best possible results (Institute of Medicine, 2014). Indeed, the interviewees believed that EMR fulfilled all of these requirements and this was evidenced many times in different interviews that EMR was critical for enhancing patients' care.

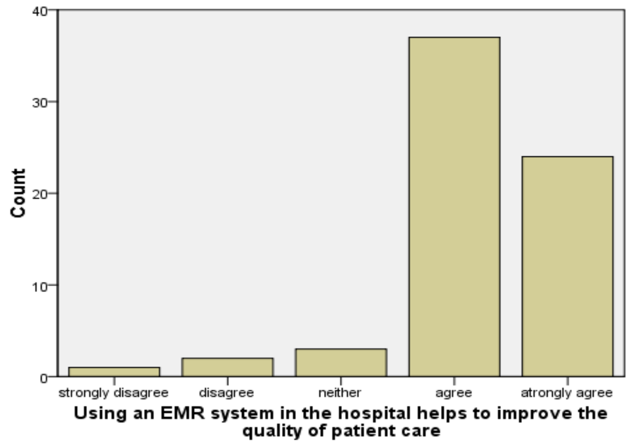


Figure 55: Using an EMR system in the hospital helps to improves the quality of patient care

From a qualitative perspective, when the nursing group participants were asked during focus group discussions, "To what extent is the quality of medical services being improved by the EMR in the hospitals?" they said:

> *"Very much improved. Before we used to struggle to access the information. For example if you needed to see a result of an important blood test made few years ago, you would have to search in many volumes of patient's paper records. The access to clinical information was very difficult and time consuming. Now you just need to press a button to get all you need. Access to patient's information is very fast now compared to before*." FGQ001-P18

6.4.2 De-motivators for further implementation

As explained earlier, there was a positive attitude toward and belief in the system. However, certain technical problems frustrated and disappointed users.

This case faced many factors that affected it negatively in terms of proceeding further in implementing EMR. Besides funding problems, there were technical and human problems that challenged them. These problems were summarised by a Medical Director as follows:

"The major challenge is to find the best software that provides the best fit for hospital needs. Other challenges and barriers include staff resistance, infrastructure, backups, training and technical support." IQ004

As summarised in Figure 56, de-motivational factors can be classified into technical, human, administrative flexibility, and funding problems. Each of these are explained in depth in the following sections.

De-motivational factors	**Technical problems**	Hardware challenges
		Software challenges
		Technical support challenges
	Human problems	Resistance to the system
		Training needs
	Administrative flexibility in adapting the system	MoH does not enable the case to adapt the system to its work
	Funding limitations	Shortage of funding

Figure 56: De-motivational factors in the second case study

6.4.2.1 Technical challenges

In this case, it was clear that, after the financial challenge to further implementation of the system, the main obstacles were technical ones. Technical problems are always a major concern as these have a negative effect on users. The Medical Director believed that the main challenge that they faced with the system lay in technical aspects, not human ones.

6.4.2.1.1 Hardware challenges

Hardware problems included a lack of computers, slow processing speed, out of date computers and no recovery systems. Quantitatively, the question which ranked as least favourable was that which concerned "Computer Adequacy". On average, this scored 2.1 with positive skewness. This indicates a significant tendency toward disagreement on the adequacy of the number of computers. Likewise, as illustrated in Figure 57, the highest score was given to "strongly disagree" regarding the adequacy of computers in the hospital. The high variance (1.33) in the results is due to an imbalance in the number of computers in all departments. However, regardless of this variance, fewer than 10% of participants strongly agreed that the system was adequate.

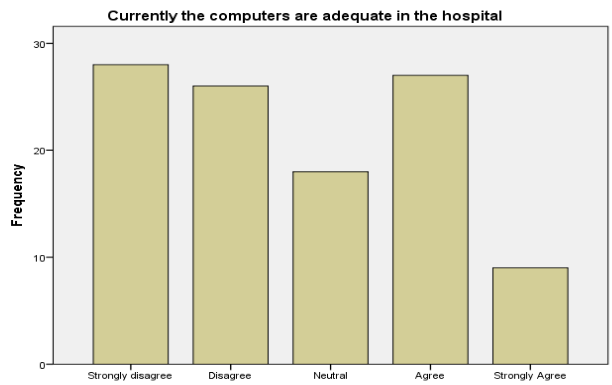


Figure 57: Currently the computers are adequate in the hospital

As with case 1, these issues disrupted the smooth flow of work in the hospital, especially since only IT professionals were able to solve technical problems. For the hospital considered in this the case, the adequacy of computers available in the hospital was scrutinised and there were more employees who disagreed that these were adequate than those who agreed with the statement. This suggests that the number of computers was not sufficient for the users, as was clearly illustrated in the following comment:

> *"As I mentioned before, the infrastructure especially in old hospitals is not supporting the advances in technology."* IQ001

> *''The few computers we have are old and slow."* FGQ002-P25

The issue of slow computer systems was also prevalent in case study two. This problem was frustrating for the medical staff and could discourage their use:

> *"Our computers are very slow and take a long time to respond to orders."* FGQ002-P24

"*Yes, they hang and freeze most of the time.*" FGQ002P-26

Indeed, the problem was not only slow computers, but also an insufficient number of them. This created queues to use computers and had a negative effect on their use.

"There is an acute shortage of computers in the hospital" FGQ002P-28

"Other concerns are about shortage of computers and lack of effective training." IQ007

The most important infrastructure issue was the inadequate system that did not give the employees the reassurance they needed that patients' data would not get lost.

"I think the infrastructure is a great challenge, especially in old hospitals like ours which are not designed properly to accommodate new advances in technology. The other thing is the lack of an effective backup system. You know X-ray images are very large and require huge space on the server. Therefore, you need a big server and a big backup system. Now we use compact discs (CDs) to keep our backup. We need a large number of CDs to keep up to date backup to our programme." IQ001

In summary, as shown in Table 41, the lack of speed, an unreliable infrastructure and backup problems were perceived as serious issues that disappointed staff and caused them to be dissatisfied with the system.

Table 41: IT infrastructure problems: themes and sub-themes

Theme	Sub-theme
IT Infrastructure problem	Old and slow computers
	Insufficient number of computers
	Backup problems

6.4.2.2 Technical support challenges

Technical challenges are magnified where there is no technical support and/or no service level agreement (SLA) with a service provider. The existence of a service level agreement is important as this could cover the lack of skills in the IT department, ensuring that the system was perceived as reliable. It should be made clear what is included in the contract and what is not.

6.4.2.2.1 Shortage of IT department skills

This was a crucial challenge as IT responses were too slow to be effective, especially at urgent times.

> *"The response of the IT is very slow in cases of system defects."* FGQ002-P29

Indeed, users felt lost once the system failed because they were not trained to recover it. On the other hand, the IT support was neither sufficient nor available to cover any breach in the system.

This problem was made worse on night shifts as there were no IT professionals at all during the night which put the system at great risk.

> *"There is no technical support or backup."* FGQ002-P27

This problem affected the system negatively, as the IT Director pointed out when he noted the *"Shortage of IT professionals."* IQ005

6.4.2.2.2 Perceived reliability of the system

This challenge was due to the fact that there was no organised technical support manager or team to manage the service level agreement (SLA) between the IT provider and users:

> *"The departments are suffering, yet the IT department cannot solve all problems. Some problems that cannot be solved by them are referred to the vendor who takes long time to respond."* IQ007

Furthermore, this problem was emphasised when many incidents occurred and there was no way to cover them. This affected the reliability of the system considerably in the eyes of the users:

"We have received many incident reports regarding problems with this current programme. (Pause), actually we are still receiving incidents from doctors and nurses about the difficulties they are facing with this system. But because we don't have an Information Management Committee to deal with these problems, we usually refer them to the IT department to be resolved. However, they are some EHR problems which can only be solved by the vendor." IQ007

The non-existence of an SLA panicked the users about the many sudden problems that could happen without any recovery plans being in place. Of course, this significantly affected the reliability of the system in the minds of users. This was also noted by a Quality Director as follows:

"I think the most important concern is about the protection, security and confidentiality of patients' information. It's very scary for doctors and nurses to feel that all clinical information can suddenly disappear from the system. Other concerns are about shortage of computers and lack of effective training." IQ007

6.4.2.2.3 Differentiating between what is included in the service package and what is not

Indeed, decision makers expected that vendors should also provide extra services such as enabling them to customise the system to fit their operations. Such excessive expectations could harm the relationship between the users and the service providers and the Medical Records Manager reported this problem as follows:

"Only the vendor is not providing the expected support especially in regard to alterations and modifications to the software to meet our needs" IQ003

This over-expectation could be because the users were not involved in the contract between the central government and the vendor so the users were not aware of what was included in the contract and what was not.

"The vendor says some of the suggestions are beyond their contract with the MoH, so they don't take any action to resolve them." IQ004

In summary, as illustrated in Table 42, a Service Level Agreement (SLA) did not exist and the lack of it led to many problems, such as a shortage of IT department skills. Thus, when the system failed, it took a long time to be repaired. This indeed significantly affected the perceived reliability of the system. Furthermore, the existence of an SLA could have enabled the expectations of both the service provider and users to be shared in a consistent matter.

Table 42: Technical support challenges: themes and sub-themes

Theme	Sub-theme
Technical Support Challenge	Shortage of IT department skills
	Perceived lack of reliability of the system
	Differentiating between what is included in the service package and what is not

6.4.2.3 Software challenges

There were some problems with the EMR system which were observed as disappointing although these problems were not major ones. It is worth noting that there were no problems with the radiology system (the system developed in-house) because it was developed and designed as a team effort with a high level of involvement on the part of users.

"We carried out a pilot test to evaluate the software on small scale. We selected the ICU as an inpatient unit and two clinics in the outpatient department. After success of the pilot test, we moved on to include all clinics and inpatient units. …………. We didn't carry out any consultations. You can say it was a result of teamwork. Four technicians worked on the programme." IQ001

6.4.2.3.1 Unavailability of a proof reading capability

With the other systems, certain problems were found to be frustrating for users, such as the lack of a proof reading capability in the system; this was because there was no dictionary facility and this led to many mistakes and communication problems across departments. This issue was raised in the doctors' focus group as one of the major concerns regarding the EMR:

> *"Selecting the appropriate diagnosis from a very long list is really unfriendly and very frustrating for all of us. I suggest that they arrange diagnoses in some way to be more friendly. I mean using lead terms, for example, like in the ICD-10."* FGQ 001-P20

6.4.2.3.2 No advanced search capabilities

This problem occurred because there was no way to search among words.

> *"This is one of the major problems of the system. I don't have enough time to go through a very long and unorganised list of diseases to find the appropriate diagnosis. I don't think I can do that in my clinic with many patients waiting outside to be seen by me."* FQ001-P19

6.4.2.3.3 Mismatch with organisational processes

Furthermore, a few other problems could be related to the mismatch between the system's design and actual current processes. For instance, software security problems arose because of the lack of clear understanding of the hospital's processes when EMR was implemented. For instance, strict security settings, such as assigning the prescription of a set of products to specific doctors, led to unexpected process-related problems.

> *"There is a problem regarding prescribing medications. You cannot prescribe some medications. The system will ask you to consult another doctor. This means you don't have the privilege to prescribe this particular medicine and you have to ask another doctor with privilege to prescribe it for your patient."* QFG001-P20

This mismatch pushed some users to carry out actions that they should not have undertaken; it might also have affected the quality of data later.

> *"I don't think I can do that in my clinic with many patients waiting outside to be seen by me. That's why some doctors just chose any*

diagnosis to be able to move on to the next steps. We know this is wrong and potentially dangerous to our patients. But this risk is created by the system not us." QFG001-P22

In summary, as seen in Table 43, software aspects of EMR carried with them some frustrating challenges. These challenges were rooted in an imperfect understanding of the users' needs from the EMR system. Therefore, there were a few (albeit major) challenges with regard to the software, such as the unavailability of a proof reading capability as users were unable to memorise all words perfectly; this led to later problems in finding data. Another challenge along the same theme was the unavailability of an advanced search facility. In turn, this significantly affected the speed of processes. Finally, this mismatch might encourage users to behave illegally as a way of overcoming this difficulty; again, this affected significantly the quality of data. All these factors had a negative effect on the users' enthusiasm for the system.

Table 43: Themes and sub-themes of software challenges in the second case

Themes	Sub-themes
Software challenges	Unavailability of a proof reading capability
	No advanced search capabilities
	Mismatch between EMR and the organisation's processes

6.4.2.2 Human challenges

Most of the users perceived that their computer skills and knowledge were good or very good, as illustrated in Figure 58. However, concerning EMR, there were human challenges.

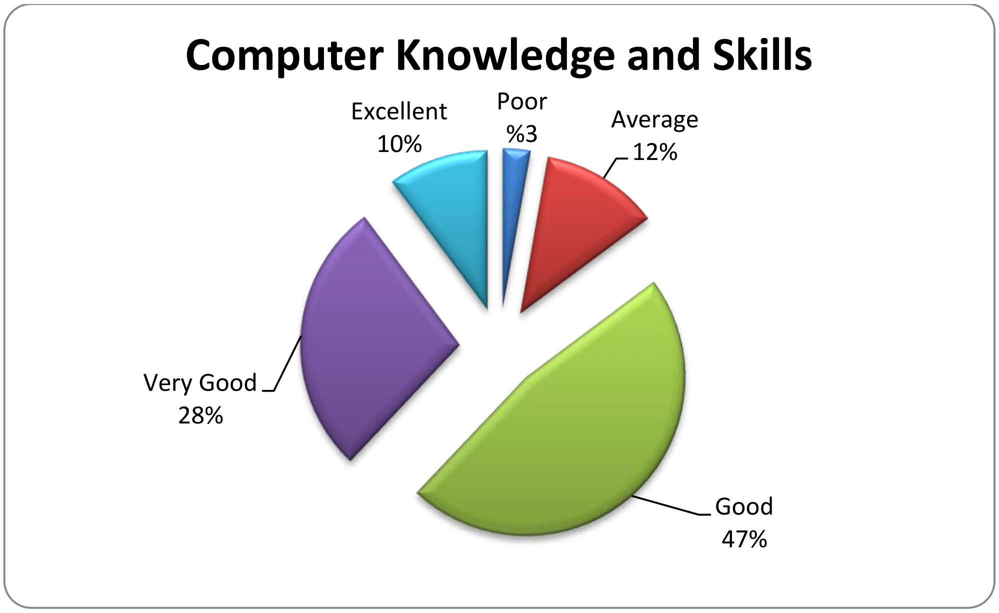


Figure 58: Computer knowledge and skills

Users are the key for a successful implementation but one of the most important concerns at this hospital was the lack of effective training. Human challenges were summarised by the Quality Director as:

> *"Lack of effective training. Shortage of supportive infrastructure. Lack of computer knowledge and skills among many doctors. Resistance to change. Lack of awareness about the capabilities and characteristics of the EMR system."* IQ007

From another perspective, the Chairperson of the Medical Directors believed that the IT department did its best to provide the optimum IT services in terms of training the users:

> *"The IT department is also doing a good job in training and providing technical support to all departments and units."* IQ004

Likewise, the Radiology Director believed that the system was easy to learn. However, the hospital kept training staff on it to get the best out of the system.

> *"Regarding the awareness, our software is very simple and can be learned in one day. Therefore, we made some lectures for the staff to explain the*

software and train them on how to use it. We also offer continuous support to the staff through telephone or physical presence of our staff to help doctors and nurses use the program." IQ001

Training was seen as a big challenge in both cases as the organisations did not want to invest much into it, considering it a waste of time and money. Indeed, clarification should be made with regard to the users' perception of the system's ease of use which is assumed by the literature to be a function of proper training (Burton-Jones and Grange, 2012).Quantitatively, most users believed that the EMR was easy to use with an average score of 3.2 and negative skewness. This can be explained as the problem was not that "interface training" was required; rather, that training was required to give users an awareness of the advanced features of the system.

Training was the key to the success and realisation of the benefits of the EMR, as one doctor in the focus group said:

> *"I think the system has more capabilities for the organisation and management of the work within the hospital. However, most of these capabilities are still not activated. Many of us are not aware of them*." FGQ001-P17

Furthermore, a lack of training without proper IT service management was a serious issue, as explained before in the section on problems concerning IT technical support:

> *"There were training courses and support at point of care. However, the shortage of the IT staff, shortage of computers and lack of p(Burton-Jones and Grange, 2012)(Burton-Jones and Grange, 2012)roper training facilities made the awareness-rising less than what is expected."* FGQ001-P18

6.4.2.3 Administrative flexibility to adapt the system

This case faced a unique challenge because of their enthusiasm for the system. The users believed that they could customise the system to fit the needs of their organisation. Indeed, they had already done this without written consent from central government by developing the radiology system internally. As a result, directors felt a good deal of bureaucracy and routine had to be overcome to change any trivial thing in the system, such as the language or the date format.

In fact, this case felt that it should be able to fix any issues or problems in the system without going back to central government:

> *"We receive many complaints from the staff about the defects in the EMR system. All amendments and updates have to be through the MoH. This is a long and time-consuming procedure. The hospital IT department has to adapt to these problems and do its best to avoid complete stop of the EMR in the hospital."* IQ005

Although *"the need for delegation to customise the EMR"* was considered a negative and frustrating factor, it could be seen as a healthy indicator that there was a high level of involvement and engagement of the users with the system.

6.4.2.4 Funding problems

Although technical challenges were considered to be restricting progress in implementing the system, they were not perceived as a critical reason for not implementing further. Indeed, this case had set up a number of plans to overcome many of these problems and had succeeded in meeting many of the challenges:

> *"We managed to improve our infrastructure within the available resources and to the extent allowed by the hospital design. We also use compact discs (CDs) to keep up to date backup."* IQ001

Financial issues were widely perceived to be obstacles that were major challenge in this case. Indeed, such issues were considered as a barrier, impeding further implementation of the system:

> *"The management should provide financial and non-financial support to make the EMR a success. We should keep moving and improving and we should never go back."* IQ002

"*I don't think they (central government) are providing any financial support to the implementation process of the system.*" IQ007

Regardless of such financial constraints towards implementing the system further, the directors of the hospital had used non-traditional financial ways (with a high level of personal risk) to establish the new system. This case obtained the money from different sources, as illustrated below in the comment of the Radiology Manager:

"We faced some financial difficulties in the early stages of the programme. When the programme was proved effective, we received financial support from the administration in the form of more infrastructures. Now we have more financial resources from training of medical students and from private patients which can help us improve our programme and general infrastructure." IQ001

However, these solutions were not considered effective for the hospital:

"The support is not up to the expected level. I can see it is only 50% of what is needed. …….. However, in my opinion, there is a need for a separate budget for the implementation of the EMR system." IQ006

6.5 Conclusion

Although there was a generally positive attitude toward the system as this case considered it to be a *"must-be a standard for all the Kingdom's hospitals"*ID003, there were negative aspects that weakened this attitude. These negative points were mainly concerned with technical and human issues. In a few words, a Medical Director summarised them as:

"It's successful. Accessing patient's clinical information has become easier and faster. However, there are still some problems and obstacles that need to be resolved." IQ004

Although human challenges existed, this case clearly had a good strategy to manage these challenges. The Chairperson of the Medical Records system stated that his committee had benefitted from the review strategy as follows:

> *"As a medical record review committee, we monitor the performance of the clinical staff on the EMR to identify the deficiencies and shortcomings. With the medical director and heads of departments we seek to minimize the staff resistance to the EMR and improve the electronic documentation of the patients' information. We also facilitate the training of the staff through periodic reports about the medical record documentation by different departments and individuals. Every day we improve and become closer to the full EMR which we all dream of. It is a long journey, you know."* IQ003

This is why the researcher observed that this case was doing better than case 1 in terms of utilising the system.

Overall, for this case, users' motivations were higher and more numerous than their demotivations which is why they had tried to seek funding from their own private funds without waiting for the complicated bureaucratic processes required to gain funding from central government. This was illustrated by an X-ray manager:

> *"It is an electronic programme that has been designed in-house. Because of limited resources (enthusiastically), this software is similar to the PACS. However, it is producing good benefits for doctors and nurses."* Q001

This idea was accomplished through cooperation between different users from different departments with internal funds. Indeed, this successful initiative had motivated central government to buy a large-capacity server.

> *"We didn't carry out any consultations. You can say it was a result of teamwork. Four technicians worked on the programme. When the administration recognized the success of the programme they supported us by buying a new big server."* IQ001

Nevertheless, they believed that problems should be addressed carefully in order for them to be overcome:

> *"The electronic health record is a good idea and will benefit our hospitals if we solve all problems and find innovative solutions for the challenges that hinder its success."* IQ007

However, the main problem that faced this hospital was the funding as this constrained everything:

> *"Every day we improve and become closer to the full EMR which we all dream of. It is a long journey, you know. All finances matter."* IQ003

Funding limitations not only affected the progress towards full implementation, they also affected the technical support and the service level agreement (SLA) with the vendor. Indeed, the vendor ceased providing technical support because of financial problems:

> *"The vendor stopped the whole system for many days because he had not received all his money from the MoH. This sudden stop jeopardized our work and forced us to go back to the manual. This is a very dangerous way to get your money from the MoH.*" IQ003

Chapter Seven: Case Three

7.1 Introduction

Based on a survey distributed to 29 hospitals in the Eastern Province, three hospitals commenced the implementation of EMR. This chapter deals with the third case. As discussed later, this case was at the highest level of implementation in the Eastern Province as it had achieved level two completely and was about to complete levels three and four. Thus, this case was considered the "success" case against which the other cases could be benchmarked. Nevertheless, this case still faced the same restricted financial limitations. Paradoxically, because of its size, the MoH was not planning to implement EMR in this case. However, after many requests from top management, the MoH decided to sponsor the EMR implementation. Therefore, it is interesting in this case to answer the question: "What are the success factors for implementing EMR?"

This chapter begins by shedding light on the context of Case Study 3. Afterwards, the data collection methods used are explained. Before presenting the final remarks with regard to this case, the findings are analysed to demonstrate the level of EMR implementation, motivations concerning further implementation and de-motivating factors hindering the desire to achieve a higher level of implementation.

7.2 Background

This hospital was built in 2005 in a rural environment with a population of 80,000. After the Kuwait-Iraqi war in 1992, because the area was close to the disputed territory, people left the region and it became deserted. Since there are many oil fields in this area, a significant proportion of the population comprises company employees and their families. Thus, a large proportion of the residents came to this city from other cities and different countries so it is now dominated by an international population working in the oil and gas industry.

This historical background reflects the hospital's current size and the nature of its human assets. From the perspective of size, the hospital is the smallest of the cases examined in this study; its capacity is only 100 beds. From the point of view of its human assets, most staff and users are international which has significantly affected the implementation of EMR, as explained later in this chapter.

7.3 Data Collection Methods

This case study used a mixed-method approach, as can be seen in Figure 59. As explained in detail in Chapter Three, four data collection tools were used: document analysis, a questionnaire, focus groups and interviews.

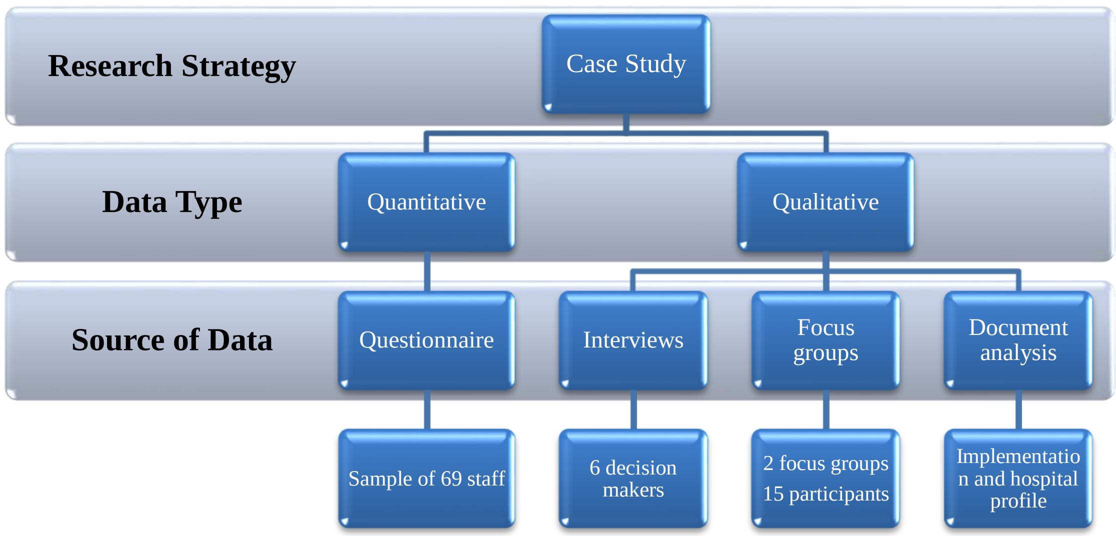


Figure 59: Data collection methods in Case 3

7.3.1 Document Analysis

A range of documents was studied and analysed while undertaking this case study. Documents used included those on the hospital's website and notice boards, implementation documents, document standards, and quality standards requirements.

7.3.2 Questionnaire

The population of this case study consisted of all the employee users within the third hospital; this consisted of 315 staff members, including 72 doctors, 166 nurses, 53 technicians and 24 administrative staff. Ninety questionnaires were distributed randomly and 69 questionnaires were returned, a return rate of 76.78%. Respondents came from all departments. Differences in demographic and computer literacy backgrounds were all represented in approximate proportion to the hospital's population by employing random sampling. Therefore, as shown in Figure 60, more than two thirds of the respondents were from medical departments (nurses and physicians) because they were the most common users of this medical system.

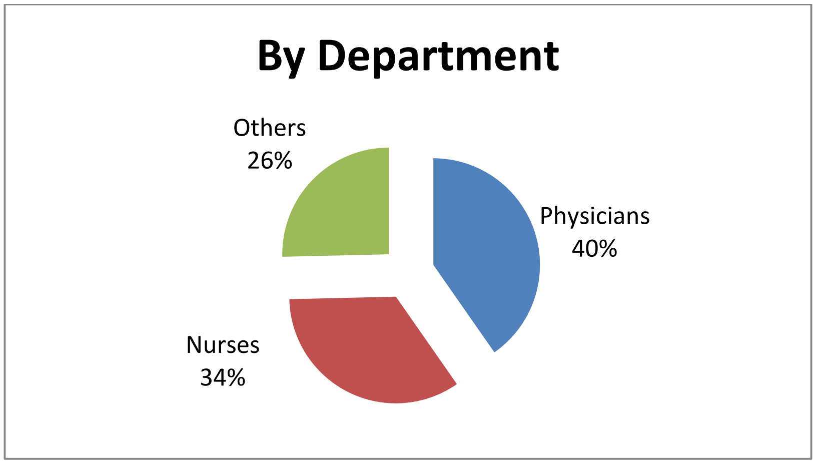


Figure 60: Survey respondents by department

7.3.3 Interviews

Six individual interviews were carried out with decision makers, all of whom had more than 15 years' experience and were aged than 30 years old. As shown in Table 44, on average, each interview took less than an hour.

Table 44: Interviewees' profiles

Code Name	Interviewee's Position	Time	Years of Experience	Age Bracket
IK001	Chief of IT	55 m	15y	40-50
IK002	Chief of Medical Records	50 m	16 y	30-40
IK003	Chief of Nursing	45 m	22y	40-50
IK004	Chief of Pharmacy	40 m	14y	30-40
IK005	Chief of Quality	55 m	26 y	50-60
IK006	Chief Medical Director	45 m	19 y	40-50

7.3.4 Focus Groups

In addition, two focus group meetings for doctors and nurses were carried out. These two groups consisted of 15 participants, the first with seven doctors and the second with eight nurses. As illustrated in Table 45 and Table 46, the nurses on average were younger than the doctors. Both focus groups took around an hour and 40 minutes.

Table 45: Doctors' focus group

Code Name	Interviewee's Position	Duration	Years of Experience	Age Bracket
FGK001		1:40		
P30	Chief of Anaesthesia		22	50-60
P 31	Chief of ER		11	30-40
P 32	Chief of Obs. & Gyn.		21	50-60
P 33	Chief of Internal Medicine		24	50-60
P 34	Chief of Surgery		18	40-50
P 35	Chief of Pediatrics		8	30-40
P 36	Chief of Ophthalmology		22	50-60

Table 46: Nurses' focus group

Code Name	Interviewee's Position	Duration	Years of Experience	Age Bracket
FGD002		1:50		
P 37	MMW Head Nurse		9	20-30
P 38	FMW Head Nurse		8	20-30
P 39	FSW Head Nurse		16	30-40
P 40	MSW Head Nurse		14	30-40
P 41	PW Head Nurse		12	30—40
P 42	Obs. & Gyn. Head Nurse		8	20-30
P 43	ER Head Nurse		9	20-30
P 44	OPD Head Nurse		13	30-40

7.4 Findings and Analysis

This section starts by defining and investigating the level of EMR implementation and then continues by investigating the motivating and de-motivating factors that affected further implementation. The study also considers why this case had achieved this notable performance in terms of reaching a higher level of EMR implementation.

7.4.1 EMR Implementation

This case had achieved most of the requirements of stage 3 and stage 4 as six systems of EMR were installed and running at the time of the study: Pharmacy, Radiology, Laboratory Systems, Computerised Physician Order Entry (CPOE), Clinical Data Repository (CDR), and Nursing Clinical Documentation (NCD). Table 47 shows that the CDR System is the main requirement for level two while level three requires the implementation of PACS and Nursing Clinical Documentation.

Although the CDR had been implemented, the PACS system had not. Nevertheless, some requirements of level four, such as CPOE, had also been satisfied. Based on the HIMSS classification, the hospital could not achieve the higher level of implementation without achieving all the requirements of lower levels which is why it was labelled by HIMSS as stage 2 not stage 4.

Table 47: EMR implementation level

Stage	Description	
Stage 0	EMR setup	Applied
	Hospital structure setup	
	EMR administrations & privileges	
	Patient registration	
	Outpatient booking	
	Inpatient admission & transfer	
	Fast & normal ER reception and functions	
Stage 1	All pharmacy functions with batch control such as store transactions, drug dispensing, etc.	Applied
	All laboratory functions such as ordering, specimen collection, specimen receiving, work lists for resulting, releasing and specimen tracking for quality control.	
	All radiology functions such as ordering, scheduling, imaging, work lists for reporting and tracking for quality control.	
Stage 2	Major ancillary clinical systems feed data to a clinical data repository (CDR) that provides physicians with access to review all orders and results.	Applied
	The CDR contains a controlled medical vocabulary and a clinical decision support/rules engine (CDS) for rudimentary conflict checking.	
	Information from document imaging systems may be linked to the CDR at this stage.	
	The hospital may be health information exchange (HIE) capable at this stage and can share whatever information it has in the CDR with other patient care stakeholders.	

Stage 3	Nursing/clinical documentation (e.g. vital signs, flow sheets, nursing notes, eMAR is required and is implemented and integrated with the CDR for at least one inpatient service in the hospital; care plan charting is scored with extra points.	Applied
	The Electronic Medication Administration Record application (EMAR) is implemented. The first level of clinical decision support is implemented to conduct error checking with order entry (i.e., drug/drug, drug/ food, drug/lab conflict checking normally found in the pharmacy information system).	
	Medical image access from picture archive and communication systems (PACS) is available for access by physicians outside the radiology department via the organisation's intranet.	Not applied
Stage 4	Computerised Practitioner Order Entry (CPOE) for use by any clinician licensed to create orders is added to the nursing	Applied
	CDR environment along with the second level of clinical decision support capabilities related to evidence-based medicine protocols.	
	If one inpatient service area has implemented CPOE with physicians entering orders and completed the previous stages, then this stage has been achieved.	

7.4.2 Motivations and De-motivations to Further Implementation

Since this case was superior in terms of its achieving a higher level of EMR implementation, it was interesting to explore why this case had been able to achieve this even when facing the same financial and governmental conditions as the other cases. Unlike the other previous cases, this case's top management was well motivated before, after and during the EMR implementation. Indeed, this case's top management aggressively sought for EMR to be implemented by making this request many times to central government. This desire to implement the system had been translated into a successful implementation in terms of realising the benefits expected from the EMR; as a result, this, in turn, translated into a superior implementation.

Consequently, the success of the EMR implementation was achieved by two main drivers: perceptions of its benefits, and information systems capable of absorbing and utilising the EMR system, as illustrated in Figure 61. Regardless of this success, however, and like the other cases, there were three frustrating and uncontrollable technical hindrances: IT problems (hardware and software), a lack of IT human resources in terms of both numbers and skills, and improper service level agreements between the case and the vendor to ensure the quality of EMR.

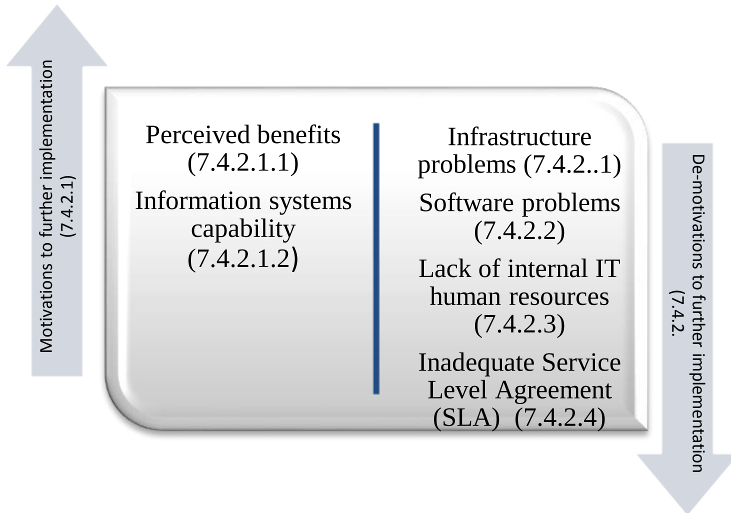


Figure 61: Motivations and de-motivations for further EMR implementation

7.4.2.1 Motivations for further implementation

Usually, the main motivator for further implementing and using the system is the perception that the system is successful; this stems from perceptions regarding the impacts of the system. The system's implementation must be perceived to be successful in the eyes of users and decision makers. Quantitatively, as illustrated in Table 48, from the questionnaire distributed to users, all respondents either agreed or strongly agreed that the current system was stimulating. Likewise, users on average scored the system as satisfying at a level of 4.61 out of five with relatively low variance since the standard deviation was 0.549.

Table 48: Attitudes toward EMR

Statement	Min	Max	Average	STDV	Skewness
The current EMR system in our department is stimulating	4	5	4.66	0.478	-0.675
The current EMR system in our department is satisfying	3	5	4.61	0.549	-1.028

Likewise, decision makers had similar perceptions, as noted many times in the focus groups and interviews. For instance, it was widely accepted in the doctors' focus group that the system was successful. When the researcher asked whether the system was successful, an answer was:

"If you want a direct answer, I can say: yes, the system is successful."
KFG001-P30

Another two participants confirmed this in the focus group:

"It is successful." KFG001-P35

"I agree with my colleagues that it's successful; however all system defects must be solved." K FG001-33

Likewise, in the nursing focus group, a participant said:

"I think it's successful in improving the quality of medical services and general hospital performance." KFG002-P37

Similarly, as illustrated in Table 49, in interviews with many decision makers, they believed the EMR to be successful.

Table 49: Successful implementation of the system---

Successful Implementation	
Decision Maker	Statement
Medical Record Director	*"There are many significant positive impacts on the hospital services."* IK002
Nursing Director	*There is no doubt that the EMR can bring many benefits to the hospital. To mention some, availability of information; fast patient and information flow; increased productivity and increased staff and patient satisfaction.*IK003
IT Director	*"Patients and staff are more satisfied with the many benefits brought by the new technology."*IK001 *"EMR improves hospital performance, quality, safety, efficiency and effectiveness of different clinical, managerial and support services."* IK001
Pharmacy Director	*"There are many benefits such as decreasing medication errors to the minimum."* IK004

More in-depth quotations concerning the success of delivering the system are presented in the "perceived benefits" section.

7.4.2.1.1 Perceived benefits

Since a benefit is the advantage perceived by a group of stakeholders, in order to judge the implementation as a success, there should be benefits perceived by the users and decision makers. Indeed, a perception of that a system offers benefits is one of the major motivators for its continued use and thus declaring it successful. For instance, the Directors of Pharmacy and Medical Records and a Medical Director described the success of the implementation by saying:

> *"The implementation of electronic prescription has many positive impacts on the quality, efficiency and effectiveness of the work."* IK004
>
> *"The implementation of electronic medical records has improved the quality of patient care and increased hospital performance and productivity."* IK002
>
> *"The improvement in quality and patient safety is significant."* IK006

Improving the quality of patient care is the ultimate goal of any initiative, and these comments show that the quality of patient care was perceived to be enhanced significantly because of implementation of EMR both quantitatively and qualitatively. In quantitative terms, as illustrated in Figure 62, roughly all respondents believed that EMR had enhanced the quality of patient care.

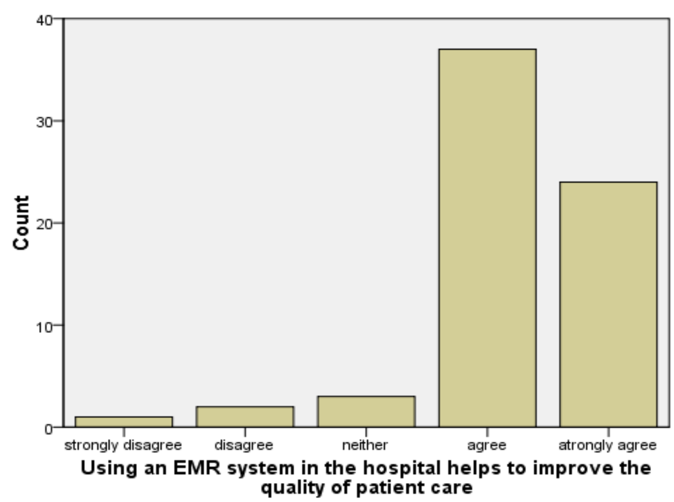


Figure 62: Using an EMR system in the hospital helps to improve the quality of patient care

Qualitatively, different decision makers showed that EMR enhanced the quality of patient care:

"In my opinion, by adopting the EMR we are able to solve the problems of the paper-based records and thus it helps us to improve the quality and safety of patient care." IK003

"I am with the Electronic Health Record as an advanced technology that can help improve the quality and safety of medical services." IK005

In order to reveal how patient care was enhanced by using EMR, it is necessary to understand the benefits interdependence (i.e., how other benefits have resulted from this benefit (Ward & Daniel, 2006) e.g. improved process benefits will decrease the service delivery time and therefore the patient risks and satisfaction are improved).

While the benefits felt by patients could be a direct benefit of EMR, these are often indirect benefits which come after other, different benefits have first been realised. The interaction between different kinds of benefit was made clear in the Medical Director's words presented below:

"There is tangible improvement in the quality, efficiency, effectiveness of care and patients' safety. The productivity of the staff and the flow of patient and information, all have increased." IK006

Likewise, the Nursing Director mentioned:

"There is no doubt that the EMR can bring many benefits to the hospital. To mention some: availability of information, fast patient and information flow, increased productivity, and increased staff and patient satisfaction." IK003

The benefits were organised into a meaningful form and were classified into decision-making benefits, process benefits and patient benefits, as illustrated in Figure 63. Patient benefits were the ultimate goal of any initiative conducted by this case while enhanced decision-making processes led to higher quality patient care. Likewise, the enhanced processes in terms of fewer errors and faster processes enhanced patient satisfaction and the quality of patient care. Roughly three kinds of benefits were illustrated in following words of a Medical Director:

"There is tangible improvement in the quality, efficiency, effectiveness of care and patients' safety. The productivity of the staff and the flow of patient and information, all have increased." IK006

"The implementation of electronic prescriptions has many positive impacts on the quality, efficiency and effectiveness of the work." IK004

Indeed, more efficient care and improved patient safety could not occur without enhancements in decision-making processes and process performance.

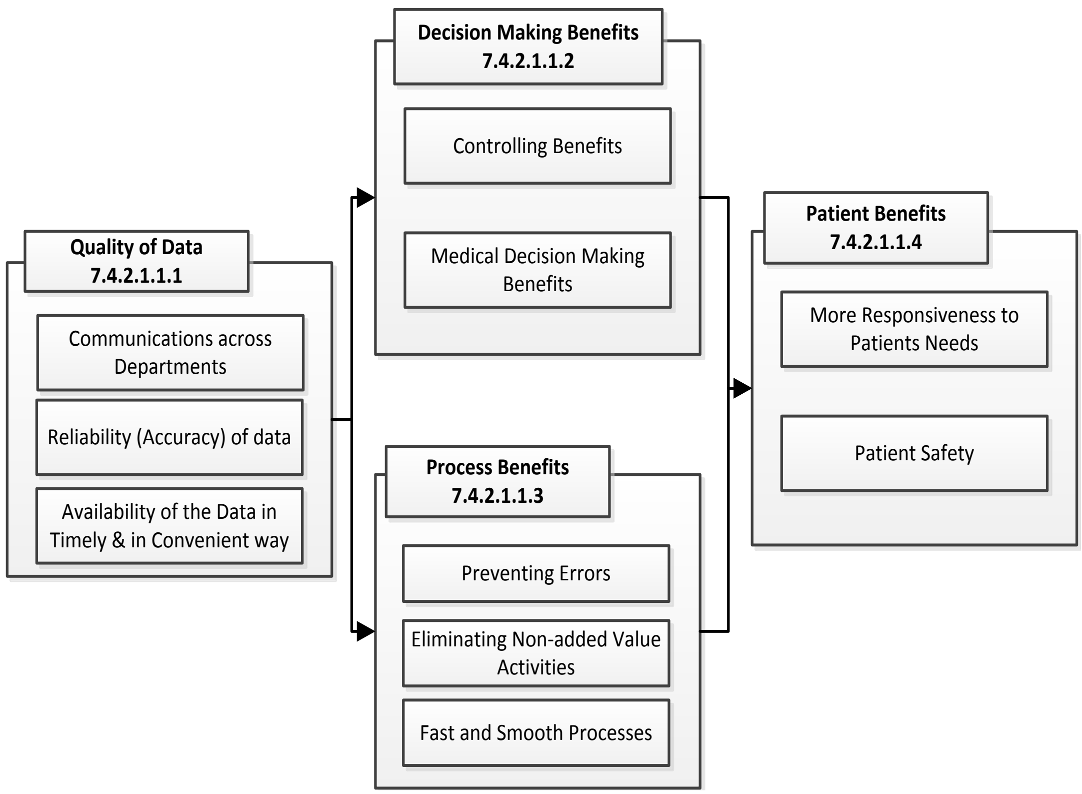


Figure 63: The relationship between information benefits, decision-making benefits and patient benefits

7.4.2.1.1.1 Quality of Data

Decision-making benefits were a positive advantage perceived by a group of stakeholders due to the existence of reliable, valid and timely data. Thus, EMR was clearly a suitable mechanism for this case to achieve decision-making benefits if it actively sought to obtain such benefits. In fact, decision makers perceived that the EMR did offer advantages such as the provision of accurate and valid data shared across departments.

These intangible benefits enhanced the hospital's controlling activities and medical decision-making processes. Both decision-making benefits had an effect on patient benefits, as illustrated in Figure 63.

> *"I just want to add that the EMR helped us to solve the problems of non-availability of medical records and lost investigation reports. These two problems of the PBMRs used to impede our efforts to provide quality care to our patients."* KFG001- P35

7.4.2.1.1.1.1 Communication across departments

Bates and colleagues suggest that clinical decision making in an ambulatory care setting is most effective when EMR is used and information is accessed during patient visits (Bates et al., 2003)**.** This only can happen when the system is integrated. Thus, if the EMR enhances communication across departments, it means that its integrative capability is successful. It is noted from the quantitative and qualitative data that this case was successful in this regard. Quantitatively, as illustrated in Figure 64, most of the respondents either agreed or strongly agreed that EMR enhanced communication.

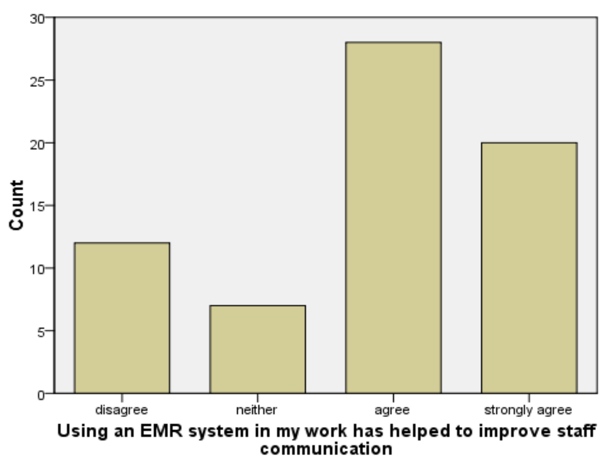


Figure 64: Using an EMR system in my work has helped to improve staff communication

Likewise, this hospital was able to enhance communication, not only across departments, but also among different staff and users of different nationalities, backgrounds and standards. There was also evidence that EMR enhanced adherence to standard practices.

"The EMR solved the problem of discrepancies among doctors. As you know, we have doctors from different nationalities and with different backgrounds, education and experience and all these differences were reflected in the treatment plans, diagnoses, progress notes and use of abbreviations. This affected effective communication among doctors. These problems do not exist anymore with the implementation of the EMR." KFG001-33

Besides enhancing and standardising the communication vocabulary across departments, standardising communication among different staff from different backgrounds enabled this hospital to overcome communication errors. For instance, one of the main perceived benefits of the system was in controlling the level of errors, as a Pharmacy Director noted:

"In my opinion decreasing or even eliminating medication errors is the most important benefit." IK004

Indeed, the pharmacy, the department that most clearly perceived this benefit, had had to face many problems and errors because of illegible handwriting:

"There are many benefits such as decreasing medication errors to the minimum, protecting the pharmacists." IK004

It was not only the pharmacy department that faced the problem of illegible handwriting but also the nurses who used instructions in a hand-written form:

"With the EMR many problems were solved, especially those related to poor handwriting. Most of our doctors' handwritten notes and orders were illegible. Nurses also have the same problem of poor handwriting." KFG002-P43

"As you know illegible handwriting is the underlying cause of many medication errors. The system helped us to eliminate the handwriting problem completely." KFG002-P43

7.4.2.1.1.1.2 Reliability (accuracy) of data

As with any other successfully implemented information system, EMR delivers accurate data to the users based on the accuracy of the inputs and this system was successful in terms of its implementation and usage pattern. If the output is correct, then it means the input and the system implementation are successful.

> *"The system can also provide accurate statistics and information for decision makers."* IK001

> *"As my colleague mentioned, the system provides valid and accurate statistics and quality measures that can facilitate decision making."* K0FG01-P31

Since the data were accurate, it indicated that the implementation had succeeded in terms of the compliance of users with the system's rules. Therefore, such accuracy (reliability) of the data helped this organisation to overcome many issues such as searching for information outside the information system (i.e. in the paper-based system):

> *"We do not waste most of our time searching for information in unorganised paper medical records. So we have more time to give to our patients and our medical work."* KFG001-P36

7.4.2.1.1.1.3 Availability of data

Reliability of the data (accuracy) is one necessary element for effective decision-making. However, the availability of such data at the right time is critical for effective decision-making.

> *"As far as the quality department is concerned, the problem was unavailability of important statistical reports. Now statistics for quality are on the computer and this meets most of our information needs."* IK005

Therefore, one of the most highly valued benefits of the system was the availability of data at the right time and presented in a convenient way. EMR succeeded in this criterion, as perceived by many directors and illustrated in Table 50. For instance, a Nursing Director said:

> *"Generally speaking the quality and access of clinical information have both improved.*" IK005

EMR had not only enhanced the accessibility of the data, but also provided them in an organised way; this, in turn, had increased the quality of the data.

> *"The EMR has increased the flow of information and work compared to the paper-based medical records. EMR is better arranged and organised and you can access any information you want in just few seconds."* KFG002-P41

The quality of this data had also enhanced the efficiency of processes:

> *"Laboratory reports and other clinical information are on the computer and can be accessed at any location or time by healthcare professionals."* KFG002-P38

> *"Besides wasting the time in the unnecessary motion of papers and staff, you cannot have access to patients' records in a timely manner. You have to write a request, send it to the medical records department and then wait for an hour or more to receive the chart."* KFG001-P32

Since the performance of processes was enhanced, the quality of the services provided by nurses in terms of their timeliness had also improved:

> *"There is also significant positive impact in terms of easy and fast access to information; timeliness of care."* IK003

Table 50: Quotations of the directors regarding the ability of the system to provide accessible data (data availability)

Position	Quotation
Medical Director	*"Accessing patient information is easier and faster from any place in the hospital. Clinical information and statistical reports are instant."* IK006
Nursing Director	*"There is also significant positive impact in terms of easy and fast access to information; timeliness of care."* IK003
Quality Director	*"Generally speaking the quality and access of clinical information have both improved.*" IK005

Doctors' focus group	*"I just want to add that, the EMR helped us to solve the problems of non-availability of medical records and lost investigation reports."*FGK001-P32. *"The information now is available everywhere in the hospital and can be easily accessed."* FGK001-P35
Nursing focus group	*The EMR has increased the flow of information and work compared to the paper-based medical records. EMR is better arranged and organised and you can access any information you want in just few seconds."* FGD002-P37. *"Laboratory reports and other clinical information are on the computer and can be accessed at any location or time by healthcare professionals."* FGK002-P41

7.4.2.1.1.2 Decision-making benefits

Reliable and readily available data enabled the decision-makers to control the activities in the hospital more effectively and efficiently than before, offering greater responsiveness to the needs of patients and protecting their privacy.

7.4.2.1.1.2.1 Controlling benefits

Although there was no evidence that there were planned activities that were controlled using benchmarks, the control focused mainly on monitoring what was going on in the hospital:

> *"Going around in the hospital, I can access any patient file to see the adequacy of medical and nursing documentation.*" IK006

It was not only the Medical Director who used the system to monitor others; doctors in the focus group also used it in a similar fashion:

> *"The hospital director or medical director in their offices can see what is going on in the hospital without moving from their chairs."* KFG001-P35

Likewise, another form of control concerned activities to stop ineligible patients receiving treatment in the hospital according to government laws:

> *"One important point is that the eligibility of patients for medical services can be easily monitored and controlled through the EMR system. Before EMR, some doctors used to treat non-eligible patients for social reasons, like friends or friends of friends. The administration could not control this*

phenomenon under the PBMRs. But now it's very difficult if not impossible to treat any non-eligible patient in the hospital." KFG001-P32

7.4.2.1.1.2.2 Medical decision-making benefits

Enhanced decision-making capabilities, if used appropriately, should affect patients. This is what is called implementation success as the benefits are perceived by different stakeholders. Indeed, not only the efficiency of processes increases, but also decision-making processes are improved since transparency among departments' increases. For instance, having data for a specific patient available to all departments would be expected to enhance medical decision making and therefore improve the quality of the services.

> *"Each patient now has a unique hospital number and a unit electronic medical record. I mean the EMR provides a complete view of patient medical history, while with PBMRs patients used to have more than one hospital number and more than one medical record. So the PBMR does not give a complete picture of the patient. Furthermore, with EMR you don't have to send request to the medical record department and wait for hours for the record to come. Now with just simple clicks on the keyboard you can easily navigate the patient records and in few seconds you can access any type of information you need about the patient."* KFG001-P31

> *"The EMR helped us to solve the problems of non-availability of medical records and lost investigation reports. These two problems of the PBMRs used to impede our efforts to provide quality care to our patients."* KFG001-P35

In this context, the study found that decision-making capabilities were enhanced due to the EMR implementation as it affected the responsiveness to the needs of patients and improved patient safety.

7.4.2.1.1. 3 Process benefits

The literature (e.g., Hunt et al. (1998); Kaushal et al. (2003)) shows that electronic health records have improved patient outcomes, quality of care, and patient safety, while the existence of information at the right time for the right person is one of the most critical aspects required for achieving the targeted benefits of the system. This case, through using EMR, had achieved this quality of data.

"The information is available at the point of care." IK002

Thus, EMR had enabled this case to enhance radically the effectiveness and efficiency of its processes. Since communication across departments had increased and there were now fewer errors in communication, the processes had become more effective and efficient than before. Indeed, as can be seen in Figure 65, EMR enabled this case to enhance its processes by preventing errors, eliminating non-added value activities, and making processes smooth and fast.

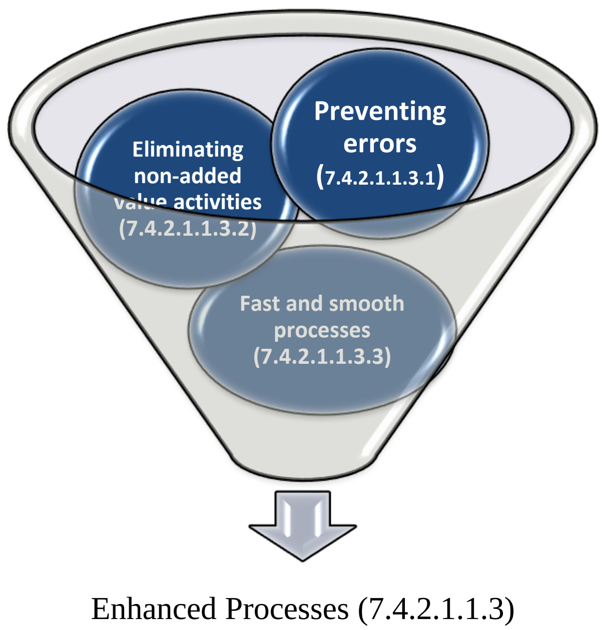


Figure 65: How EMR enhanced organisational medical processes

7.4.2.1.1.3.1 Preventing errors in the processes

Quantitatively, it was widely perceived that EMR had significantly decreased medical errors. According to Figure 66, almost no one disagreed that EMR decreased errors; rather, most of the respondents either agreed or strongly agreed with this statement.

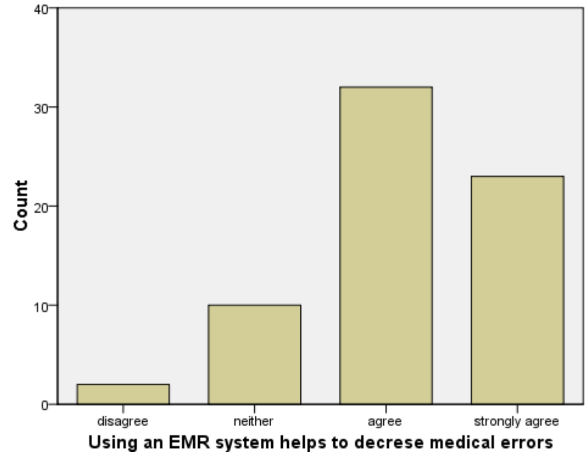


Figure 66: Using the EMR system helps to decrease medical errors

In more depth, and speaking in qualitative terms, errors were usually prevented before they occurred. From nurses' perspective, overcoming the handwriting problems, besides overcoming the errors in medication, helped processes to become more streamlined as before, nurses wasted time trying to understand puzzling writing or finding someone who could help to read unreadable texts:

> *"Illegible handwriting not only caused medication errors but also wasted our time. When we received a prescription that was handwritten and the writing was not clear the nurse had to go around looking for someone who could read it. This used to take much of the nurses' time."* KFG002-P44

This enhanced performance resulting from controlling the errors in communication due to poor handwriting was widely perceived, not only by nurses, but also other departments such as IT and Quality.

> *"Errors and defects are very much fewer now; this is reflected in improved performance, efficiency and productivity."* IK001

> *"The problems related to poor handwriting do not exist anymore and thus medical errors due to poor handwriting have been minimised or eliminated."* IK005

This system had the ability to prevent errors in data entry and this therefore led to the quality of data being enhanced in terms of accuracy. An example from the patient registration department is presented below:

> *"Registration of new patients is easier now and patients' demographic information is complete because the system does not accept deficient identification data."-* KFG002-P38

Likewise, the system forced physicians to complete information before going on to the next step:

> *"Yes, it saved our time and efforts. With the PBMRs the medical records department used to call us to complete deficiencies in patient charts. This used to take time. Now the system forces physicians to enter complete information in each step on the medical record form before they can move to the next step or form."* KFG001-P34

7.4.2.1.1.3.2 Eliminating non-added value activities

The enhancements in communication across departments enabled this case to be more efficient by removing all activities that consumed time without adding any value. For instance, unnecessary medical tests are non-added value activities. EMR decreased these unnecessary tests according to the users (see Figure 67).

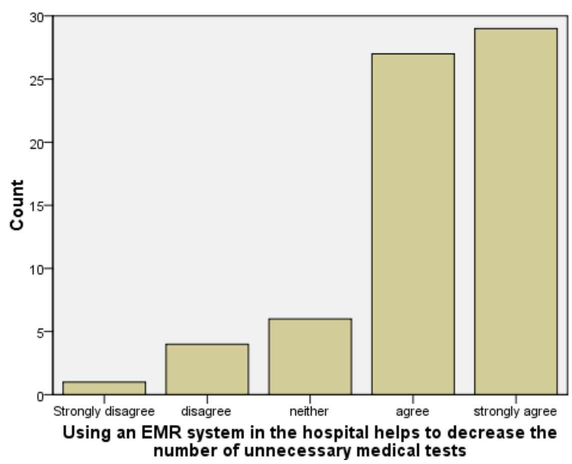


Figure 67: Using an EMR system in the hospital helps to decreases number of unnecessary medical tests

Another example illustrated the elimination of non- value added activities:

"With EMR you don't have to send a request to the medical record department and wait for hours for the record to come. Now with just simple clicks on the keyboard you can easily navigate the patient records and in few seconds you can access any type of information you need about the patient." KFG001-P31

Likewise, the communication between nurses and the pharmacy improved because the EMR enabled this case to remove non-added value activities from its value chain.

"There is the medication list. Before, nurses used to bring medication sheets from their inpatient units and then come back again to collect their medicines. Now with electronic prescriptions they do not need to send any papers to the pharmacy or even go there. Now all these things are done through our electronic prescription system." IK004

7.4.2.1.1.3.3 Fast and smooth

Besides being leaner by overcoming non-added value activities, processes in themselves became even faster than before. Quantitatively, as shown in Figure 68, the number who strongly agreed with this outnumbered those who strongly disagreed and disagreed. In other words, most respondents believed that communication had been enhanced.

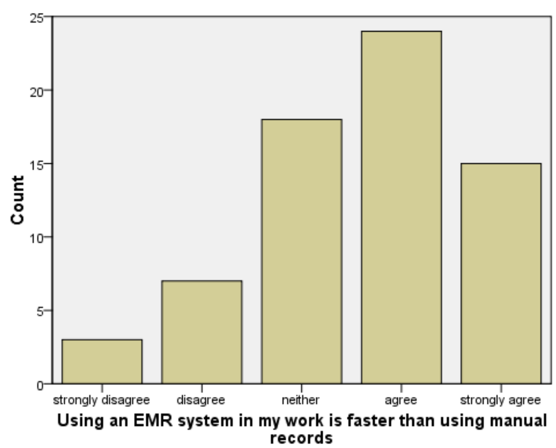


Figure 68: The EMR system is faster than using the manual one

Qualitatively, the same perception was shared across decision makers:

"The work now is fast and smooth. Patient and information flow is faster." IK001

This streamlined process came as result of the fast movement of information across departments:

"There are many good impacts on the hospital services. Recording and flow of information is easier and faster now. Doctors are keen to enter their notes for each episode or encounter in time to avoid any delay in workflow." IK005

Thus, it is sufficient to say that faster processes meant greater responsiveness and more efficient reactions to customer needs:

"The flow of patients within the hospital is faster." IK002

7.4.2.1.1.4 Patient benefits

Both decision making and process benefits enabled this case to achieve patient benefits. Patient benefits in this context can be described as patients' privacy and safety, and responsiveness to patients' needs. Quantitatively, users believed that the EMR radically enhanced the safety and privacy of patients, as shown in Figure 69.

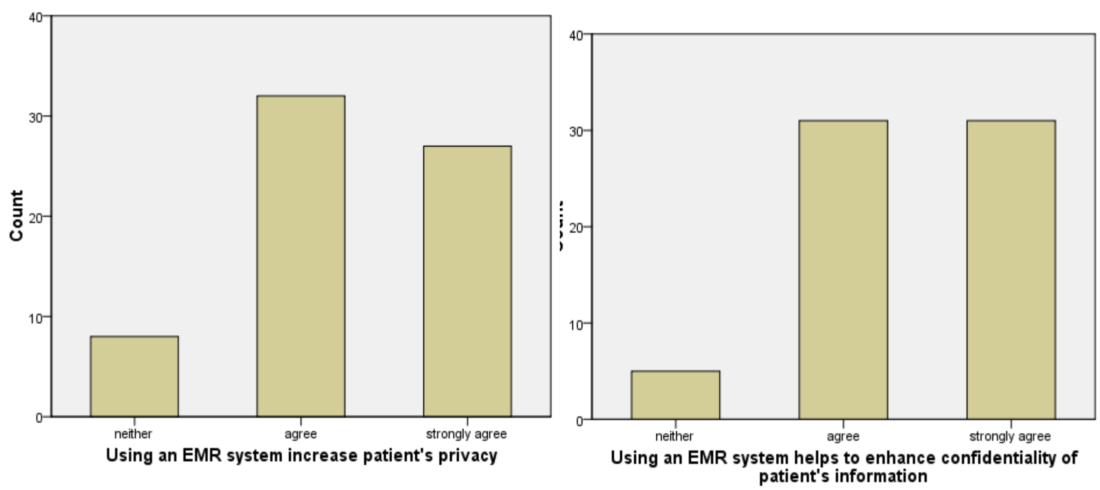


Figure 69: The impact of EMR on patient privacy and confidentiality of patient's information

7.4.2.1.1.4.1 Patient safety

EMR offers enhanced data accuracy which in turn helps in avoiding medical errors. Pharmacists were most likely to perceive how EMR enhanced decision-making processes achieved a higher level of patient safety. It is not only the illegibility of handwriting that affects patient safety, but also drug interactions. Thus, a patient's current medication file helps to identify which medicine is appropriate for each patient:

> *"The electronic system can give an alert to doctors in case of drug to drug interaction and about medications that can cause allergy to the patient."* IK004

Moreover, due to enhancements in the processes in terms of fewer errors, the elimination of non-added value activities, and the creation of faster and smoother processes, the EMR system enabled this hospital to enhance its patient safety and privacy in many ways. The key point in this relationship was the availability of quality data in terms of their relevance, timeliness and accuracy.

> *"I can say that patient care has much improved with the EMR. All information needed for providing quality patient care in a timely manner is available on the system."* KFG002-P42

For instance, overcoming the problems caused by poor writing increased patient safety by decreasing errors in communication between parties such as physicians, nurses and the pharmacy. The Pharmacy Director summarised the importance of the system in overcoming such problems by saying:

> *"I want to say that the most significant benefit is improving patient safety through decreasing medication errors. As you know, one illegible letter in a drug's name can cause a disaster. For example, volterine and ventoline sound alike and if the doctor's handwriting was illegible this could cause harm to the patient if the wrong medicine was dispensed."* IK004

However, in the literature, there were some concerns that EMR might increase risks to privacy as data are available anywhere to anyone. However, the decision makers in this case held a contrary belief:

"We don't have any concerns about safety, security and confidentiality with the use of the EMR. On the contrary, the EMR manages to solve all these problems, which we used to have with the PBMRs. Each person has his or her own username and password and can only access the information needed for patient care. He or she cannot tamper, modify or delete any information from the system. PBMRs are exposed to addition, deletion, alteration and modification. Unlike the PBMRs the EMR offers better legal protection to the physician because no one can tamper with the information he or she fed into the system. I think the EMR is 100% secure, confidential and safe." KFG001-P30

7.4.2.1.1.4.1 Greater responsiveness to patients' needs

Besides eliminating the non-added value activities, the availability of a patient's history in EMR enhanced decision-making processes in terms of understanding the patient's needs more quickly. Indeed, this shortened the decision-making time radically so that patients were served faster than before:

"Doctors used to take a longer time to trace different types of clinical information such as history, previous treatment and diagnostic reports. Unlike PBMRs, EMRs are integrated and organised and accessing information is faster and easier." KFG001-P30

7.4.2.1.2 Information system capabilities

Capability is the ability of an organisation to utilise its information system to achieve the desired benefits. In this case, as illustrated in Figure 70, the capabilities that were found to be enablers in terms of absorbing and utilising the EMR easily were the competences of human resources and top management.

Figure 70: Information system's capability

This case, as discussed in the earlier background information, was not selected for an EMR implementation by the government's health department. However, the top management was very active in requesting its implementation. These strenuous efforts made to affect the government's decision succeeded in the end and this gave them the potential for success. Unlike the other hospitals which implemented EMR after using the manual system, this case had implemented different applications before implementing the EMR:

> *"There were many local efforts to design software by the IT department. We used some electronic records programs but they were not comprehensive. Then we were informed that the Ministry of Health (MoH) was planning to install EMR in 30 hospitals in the Kingdom. We requested our hospital to be one of these hospitals."* IK001

Therefore, once the MoH assessed this hospital's readiness to change (i.e. its human resource competence), the Ministry found it deserved to implement the EMR more than other hospitals.

> *"A team from the MoH visited the hospital and they found the hospital and staff enthusiastic to use the EMR. So, they put our hospital forward as one of the 30 hospitals for implementing the EMR. (Smiles) I can say that the idea of the EMR was initiated by the MoH because they purchased and installed a comprehensive program in our hospital and in 29 other hospitals across the country."* IK001

Thus, this case is classified as a pull-change implementation since the top management sought the change and implemented it; the users were also ready and wished to implement it. This was made clear in the medical focus group when the success of these efforts was discussed:

> *"It was the idea of our previous hospital director. He contacted the Ministry of Health (MoH) and they agreed to install a full EMR in our hospital as one of 30 hospitals selected by them."* KFG001- P30

Another member of the medical focus group followed up by addressing the desire of users to implement the system:

> *"Our previous hospital director was enthusiastic to adopt the EMR, but the practical step came from the MoH because they had a plan for EMR in all MoH hospitals. They selected our hospital because they found the people here **willing** to use the EMR."* KFG001-P 35

7.4.2.1.2.1 Human resource competencies

Two main factors were discovered in the analysis as being critical for the success of an implementation: the age of users, since this affects their enthusiasm for change; and being influenced by international staff who had used similar systems before in their home countries.

7.4.2.1.2.1.1Enthusiasm for change

Quantitatively, this case had unique demographic characteristics which differentiated it from the other cases. The staff, based on the sample, were predominantly male, 65% were under 40 years of age, and 46% of them had worked for this hospital for a period of less than a two years when being in a position for a long time has an impact on the acceptance of new technologies (Venkatesh et al., 2012). Gender and age are two of the major factors that affect the acceptance of new technology according to the Theory of Acceptance Model (Venkatesh et al., 2003; Venkatesh and Bala, 2008) and this researcher found that these factors were reflected in the enthusiasm of users to implement the new EMR. This enthusiasm is reflected in the following statement:

“The team was impressed to find enthusiastic employees supported by committed administration who all want to make the change. They found that the hospital has relatively good infrastructure and experience in using computer software. The team recommended our hospital to be included in the 30 pilot hospitals for comprehensive EMR.” IK001

7.4.2.1.2.2 Experience with previous systems

With regard to this point, the nature of those users who actively sought to implement the EMR was examined. These were found to be young international staff and these two factors are thought to affect users’ readiness for change. Based on Human Resources department documents, roughly 51% of the users were international staff and the presence of international staff, either as users or decision makers, was perceived to be a critical factor in increasing an organisation’s readiness to change. Many of them had previous experience of dealing with EMRs. Quantitatively, 23% of the respondents stated in the questionnaire that they had some experience of EMRs before working in this case hospital. Thus, they did not have the high level of resistance of those users who had never dealt with this system before:

“I am used to the EMR because I worked in a hospital back home which used it. The program was similar to the one we have here. We all know that the electronic system is helpful and has many advantages over paper-based records but here I didn’t find medical secretaries to feed the data into the system.” KFG001-P35

In brief, as illustrated in Table 51, this case has two intangible non-IT human assets (Melville, 2004) which enabled it to outperform other hospitals: the age of the users and a dominance of international staff. As Venkatesh (2012) stated, age is one of the factors that affects the diffusion of new systems. In this case, it was found that the young age of the users and decision makers affected the level of enthusiasm to implement the new system. Additionally, the dominance of international staff who already had a positive experience with similar systems in their home countries, decreased resistance to the new system as they were familiar with it.

Table 51: Human Resource Competencies

Themes	Sub-themes
Human resource competencies	Readiness to change (enthusiasm for change)
	Experience of similar systems (as the most of the staff were international and were used to working with similar systems in their home country)

7.4.2.1.2.2 Commitment of top management

This is a dominant factor in the success of an implementation. Like studies such as those of Poon et al. (2004) and Miller & Sim (2004), this research found that top management had a prominent impact on the success of the EMR implementation and it can be seen in this case both quantitatively and qualitatively. Quantitatively, as tabulated in Table 52, the statements regarding the commitment of the top management were significant, with responses to both statements being around the mid-point (3). No one disagreed that top management was committed to supporting the use of the EMR system. Indeed, the top management commitment was addressed by many interviewees and in the focus groups as one of the critical factors in the successful implementation of the system.

Table 52: The commitment and support of top management towards EMR implementation

Statement	Min	Max	Average	STDV	Skewness
Management is committed to and supportive of the use of the EMR system	3	5	4.28	0.714	-0.478
Senior managers are helpful in facilitating the use of the EMR system	2	5	3.93	0.942	-0.519

An in-depth analysis of the qualitative data showed that top management was able to commit to the implementation in all its phases: before, during and after. This commitment started before the system was implemented by management making requests to the MoH to obtain the system. Additionally, management commitment was clear at the time of the implementation and in the post-implementation phase as regular meetings were organised during the implementation and strict rules were enforced to avoid returning to the traditional manual methods.

7.4.2.1.2.2.1 Pre-implementation commitment

Pre-implementation commitment was apparent by the management pushing the government to implement EMR; this was mentioned by many decision makers. For instance, the Medical Director explained the story of the implementation:

> *"The idea of adopting the EMR was initiated by our previous hospital director. By the way our hospital was not at first one of the 30 hospitals selected by the Ministry of Health (MoH) for implementing the electronic medical records, but our previous hospital director convinced the MoH to include the hospital in place of one of the hospitals in the region. So, I can say that the EMR was initiated by the MoH because it made a contract with a company and purchased the software."* IK006

The IT director offered the same story:

> *"The idea was first initiated by the previous hospital director. We bought, improved and used a small computer program for patient registration for 3 or 4 years. In 2009 we sent a letter to the Ministry of Health (MoH) asking for a comprehensive electronic medical record software.The MoH responded to our request by sending a professional team to evaluate the hospital."* IK001

7.4.2.1.2.2.2 Commitment during the implementation: following up the implementation

Commitment during the implementation was reflected in the continuous support offered by management during the implementation; regular meetings were organised to follow up progress and motivational techniques to implement the system were used.

Support during the implementation

Effective support was provided by top management, as illustrated quantitatively in Table 52. Qualitatively, the same point of view was shared by the decision makers as the IT and Pharmacy Directors said:

"The administration facilitated the process by providing all necessary requirements." IK002

"We find the support of the medical director invaluable regarding forcing the use of electronic prescriptions." IK004

Follow up by regular meetings

Since the top management was actively seeking to implement the EMR, they followed up the implementation closely. This commitment is illustrated in the following statement:

"The previous hospital director played a role in making the implementation successful. He used to personally follow-up all actions and processes in all departments. He was very committed to the EMR because he was the one who initiated the idea in this hospital." IK002

Regular meetings were conducted as follow up, as explained by the Nursing Director:

"The previous hospital director played a significant role in the implementation process. This was done through daily follow-up, regular meetings, encouragement and sometimes, disciplinary actions. I can say the hospital leaders are very committed and supportive to the EMR." IK003

The same point of view was shared by the Quality Director:

"There is support from the hospital director and medical director through regular meetings and daily follow-up." IK005

And also the IT Director:

"There were regular meetings between the hospital director and department heads to discuss the implementation process and solve problems encountered during the process." IK001

The Medical Director noted:

> *"The hospital administration supports the implementation of the EMR through regular meetings and follow up."* IK006

The follow up was conducted with a great deal of care as the top management personally followed each step of the implementation:

> *"The previous hospital director played a role in making the implementation successful. He used to personally follow-up all actions and processes in all departments."* IK002

To sum up, as illustrated in Table 53, the competence of the top management in following up the implementation was important and top management support and commitment during an implementation is known to be one of the most important critical success factors in IT implementations.

Table 53: Top management commitment during implementation

Theme	Sub-themes
Top management commitment during implementation	EMR top management support
	Close follow up of the implementation

7.4.2.1.2.2.3 The post-implementation commitment

The post-implementation commitment was reflected in terms of directing users to perform the intended behaviour by using both "sticks and carrots" (Medical Director). Likewise, the Quality Director explained the approach of top management in controlling the required behaviour with regard to the implementation as follows:

> *"There is encouragement to all staff to use the program and there is disciplinary action against those who resist the EMR implementation."* IK003

The strict and decisive management style to enforce implementation was made clear by the interviewees:

"As I told you we encourage the staff but at the same time we use disciplinary actions against those who continue to resist." IK006

"In my opinion, the hospital administration has done a good job placing all these pressures on the medical staff to continue use the system. Otherwise, the system could have failed in the hospital." KFG001-P34

Any violations from the intended behaviour with regard to the new management system were captured and analysed; then, corrective action was taken. The management put into action automatic mechanisms so that the required behaviours were not violated. For example, manually written prescriptions were not allowed to be dispensed by pharmacists:

"For the electronic prescription there is a memo from the medical director that the pharmacy mustn't dispense any medication on paper prescription. The medical director asked us to send to her all paper prescriptions to question the doctors concerned. She also took disciplinary actions against some doctors." IK004

Furthermore, any incident of violating the rules was reported to top management for them to take decisive action. For instance, any prescription which was manually written had to be reported to a higher managerial level for them to find out why this had happened:

"Yes, at the beginning the administration placed great pressures on the staff especially the doctors to implement the EMR. Doctors who didn't use the EMR in their daily work were questioned and disciplined. There was daily follow up from the medical director and hospital director on the performance of the staff on the EMR." KFG001-P34

Conversely, there were extrinsic and intrinsic motivations for the proper use of the system. The extrinsic motivations were financial incentives for those departments which used the system appropriately:

"There were also incentives for departments that used the software in the right and proper way. These incentives ranged between letters of thanks and provision of equipment." IK001

Additionally, intrinsic motivators were used in terms of acknowledgments and letters of thanks:

"I received a letter of thanks and appreciation for using the system as routine in my daily work." KFG001-P32

Overall, as summarised in Table 54, post-implementation commitment was reflected in the efforts devoted to control the users' behaviour in order to obtain business value from the EMR system. These efforts were based on motivating users to be aligned with the desired behaviour and punishing undesired behaviour.

Table 54: Sub-themes of the post-implementation commitment theme

Themes	Sub-themes
Post implementation commitment (controlling intended behaviour to successfully implement the system)	Punishment to enforce implementation
	Motivation (intrinsic and extrinsic motivators)

7.4.1.2 De-motivations to further implementation

Generally, the main hindrance to further system implementation was not a people-related issue as in cases in the literature; rather, the main obstacle was technical problems:

"I think the system is relatively successful. I said relatively because there are daily problems with the system. Most of these problems are technical and if solved will definitely contribute to its success." KFG001-P32

From a user's perspective, there was no real resistance to EMR implementation, as found in the quantitative indicators of attitudes towards the system, and as revealed in Figure 71. On the contrary, all indicators showed that there were positive attitudes toward the system. Users did not regard the system as difficult to learn and most of them agreed it was easy to learn, satisfying and stimulating.

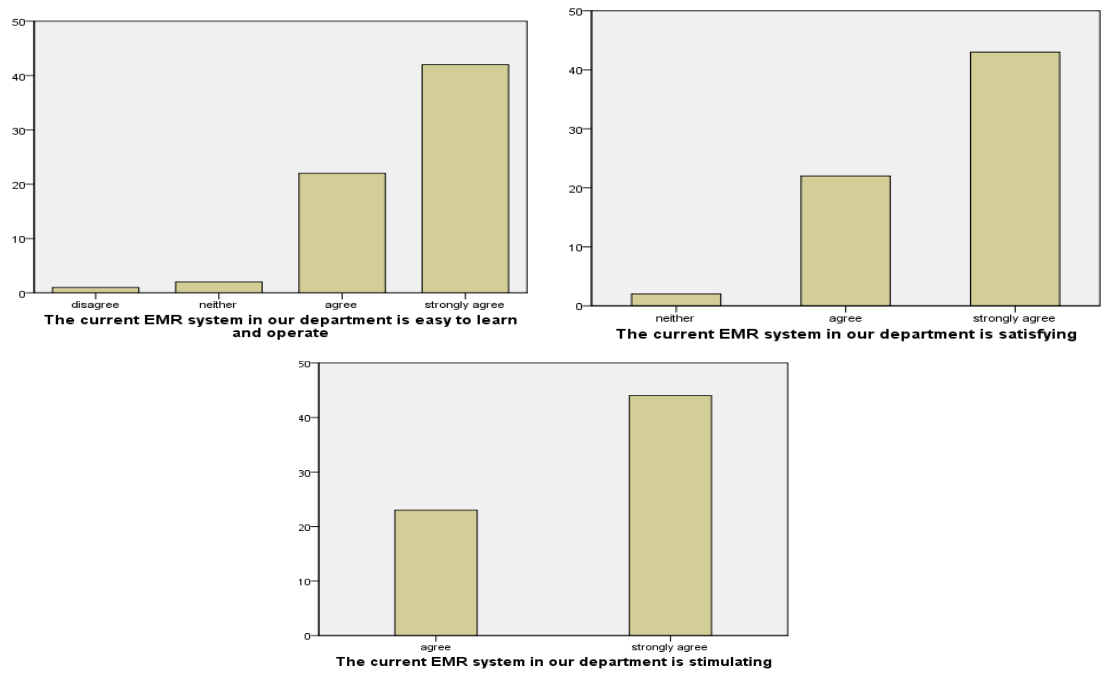


Figure 71: the current EMR system in our department is easy to operate and satisfying and stimulating

Unlike the IT literature that often perceives that people are the main obstacle to the success of an implementation, this case (like the other two cases) was faced with technical issues that had arisen because the government had a strict budget for IT investments. These technical problems affected the general attitude towards the EMR although, as previously shown, there was a very positive attitude toward it; most users found it easy to learn, stimulating and satisfying although there were fewer examples of very strong attitudes: i.e., claiming it was wonderful or reports of feeling relaxed while using it (See figure Figure 72).

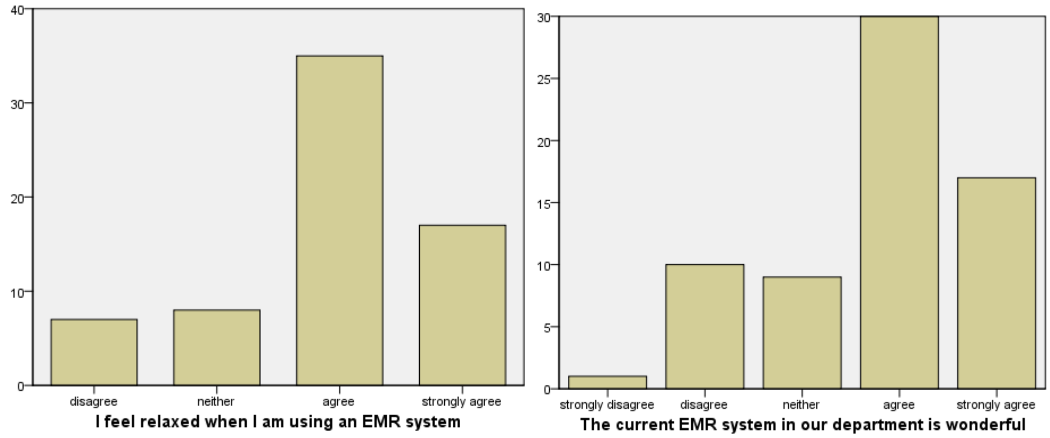


Figure 72: EMR is relaxing and wonderful

As illustrated in Figure 73, two main problems pushed the organisation to return to a manual system: the inadequacy of the IT infrastructure in terms of the quality of computers and network availability; and software related problems. Indeed, the problem was exaggerated in this case as this hospital faced a shortage of IT human resources who could fix problems quickly. Also, there was no proper Service Level Agreement (SLA) with the vendor to ensure the system was properly maintained.

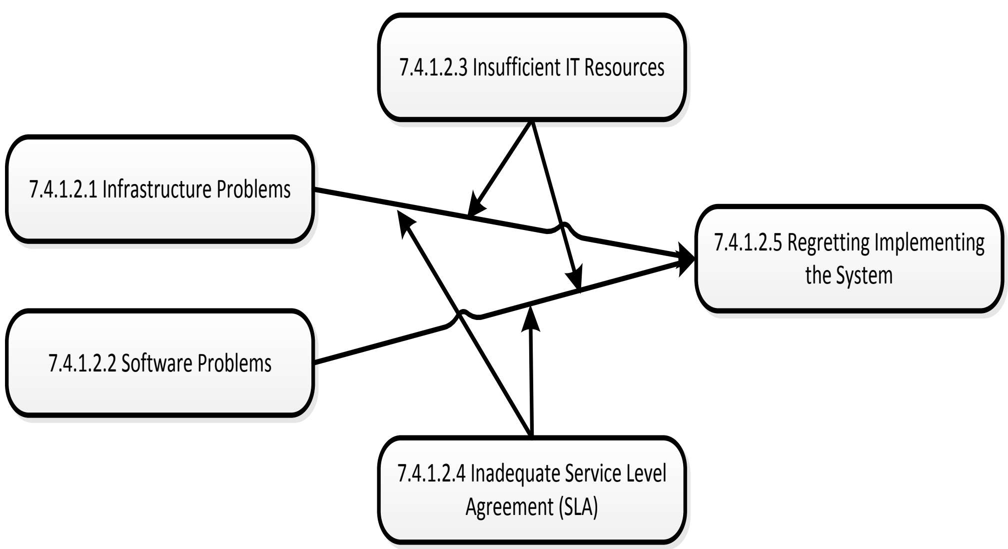


Figure 73: IT de-motivational factors

7.4.1.2.1 Infrastructure problems

Paradoxically, it was found quantitatively that the computers were adequate on average with an acceptance level of 4.1. However, the adequacy of the computers and the IT infrastructure was one of the main aspects that hindered further implementation. This problem is summarised in the statement below:

> *"Most the problems are technical. I can summarise that in the following: the system needs continuous updates, regular maintenance and updates of computers, servers and network."* KFG001-P36

> *"The computers are very slow; system response is very slow, computer freezes and completely stops during patient care."* KFG001-P35

Although users' perceived that the computers were adequate, decision makers pointed out that the infrastructure was inadequate for the system:

> *"The infrastructure is crucial before even thinking of the EMR. The government must establish a proper infrastructure in the hospital before purchasing the program. In this regard, I want to mention two problems. The servers in our hospital are too small for the huge program. The other thing is the shortage of computers. Doctors and nurses face great difficulties every day in entering their notes on the system."* IK006

The explanation of this paradoxical phenomenon was probably the top management's commitment to deliver the best computers for the users. Unlike in the other cases, the top management had usually sought to buy computers for their users:

> *"We bought more computers but it is still not enough."* IK006

Nevertheless, other decision makers, such as the Quality, Pharmacy and Nursing Directors, recurrently blamed the IT infrastructure:

> *"(There is an) inadequate infrastructure including shortage of computers, printers, cables and switches. The system is very slow; it freezes and shuts down."* IK005

> *"I think the shortage of computers, printers and IT professionals are serious problems*." IK004

> *"I think the lack of the necessary infrastructure, especially computers, is a major challenge."* IK003

7.4.1.2.2 Software problems

Although hardware problems were a hindrance to further implementation, software problems also occurred continuously and frequently:

> *"There are technical problems that happen every day. For example a sheet that doesn't open or the system suddenly hangs and stops. These are very annoying for both the physician and the patient."* KFG001-P31

Software problems were more critical since they could not be fixed easily:

> *"The IT professionals only solve hardware problems but most problems are with the software not the hardware."* KFG001-P 31

There were two reasons for this problem. First, the internal human IT resources were not able to fix software problems. Second, there was no appropriate Service Level Agreement (SLA) to identify when the vendor should come to fix the problem and how much time it should take from the time of the incident to the time the problem was resolved.

7.4.1.2.3 Lack of internal IT resources

From among the 300 employees in the hospital, according to this case's documents, there were only four IT professionals. The problem was not limited to the lack of IT personnel; their technical skills were also limited. The current expertise in the hospital was insufficient to fix software problems:

> *"The program needs continuous maintenance and update….. Although he is a hardworking and cooperative man, he lacks expertise in the software and can only solve minor problems. Major problems can only be solved by*

the company but it is very far away from here and their response is very slow and sometimes they don't respond at all." KFG001-34

7.4.1.2.4 Inadequate Service Level Agreement

A Service Level Agreement is the binding contract between the vendor and the system's user to identify the service quality level in terms of many factors, such as the time taken to resolve incidents in the system (Yamakawa et al., 2012). In fact, incidents took too much time to be resolved so the service provided by the vendor was not reliable:

> *"Technical support from the vendor is not up to our expectations. The vendor's main office is in Riyadh, which is around 700km from here, so it takes 3-5 days for the company to respond to our needs for fixing urgent problems. There is no good backup system. We are not also aware of the details of the contract with the vendor and we don't know exactly his responsibilities. Sometimes we request some modifications in the program but the vendor apologies, claiming that the requested modifications are not included in his contract.*" IK001

The Quality Manager commented on the flaw in the contract, i.e. the Service Level Agreement (SLA), with the vendor:

> *"The contract with the vendor should be discussed with the potential users to ensure that the computer company provides good after-sale services."* IK005

Without an effective SLA, there was no reliability in the system and this affected the service quality significantly which, in turn, undermined the perceived benefits. These daily incidents were perceived to be a serious problem:

> *"They give a bad impression about the hospital. There must be a separate operating budget and qualified IT professionals to keep the system running smoothly.*" KFG001-P31

Indeed, the respondents blamed the IT department which was not aware that there was something called an SLA which could manage the relationship between the hospital and the EMR vendor:

> *"In my opinion the program itself is complicated and doesn't allow updates and upgrades. All major modifications which we need are sent to the company headquarters. This is taking a long time to get feedback from them. Most of the time we find ourselves forced to live with all the defects in this system."* K FG001-P35

In addition, due to the non-existence of a clear SLA, users did not know what could be changed and what could not. All this led to frustration and disappointment for the users of the system:

> *"I think the system has limits and modifications cannot be made on a wide range. The major changes we want in the system are very expensive to the company and I believe that this is the main reason why they do not respond to all suggestions. The company apologizes about making some modifications because they say these modifications are not within their contract with the MoH."* KFG001-P36

7.4.1.2.5 Returning to a manual system

The only reasons noted for returning to the manual system were not related to human issues but rather to technical ones. Infrastructure problems, supplemented by an inability to solve incidents quickly because of a shortage of internal IT professionals and a lack of commitment from the vendor in terms of quality of service since there was no SLA, were the main frustrations for users. It was reported at various times by different decision makers that the system was shut down for certain periods and that this forced the hospital to use the manual system so that their daily work was not interrupted:

> *"Sometimes we encounter system shutdown and such situations force us to go back to paper records. It is hard to go back from electronic to paper and then again back to electronic. We have to enter heaps of paper*

prescriptions on the system when it comes back to work but some papers get lost in the middle." IK004

"The environment here is affecting the smooth running of the system. We get frequent defects in the program. Sometimes the system shuts down because of the rain, high humidity and sand storms. These environmental factors compel us to go back to paper records and this cause's great inconvenience to the staff." IK003

"There is no adequate backup system and we have to go back to paper records from time to time due to system shutdown." IK002

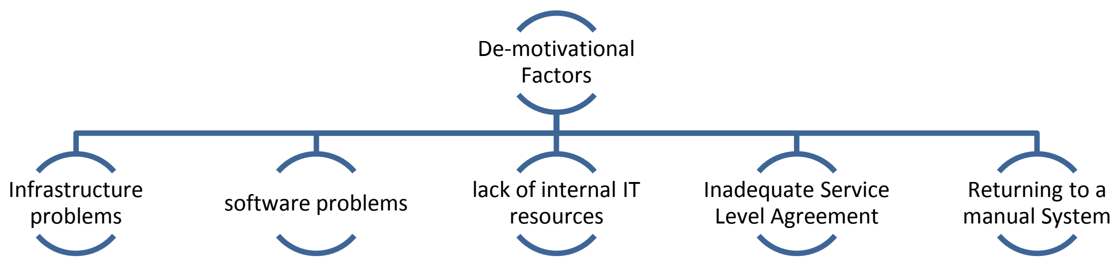
7.5 Conclusion

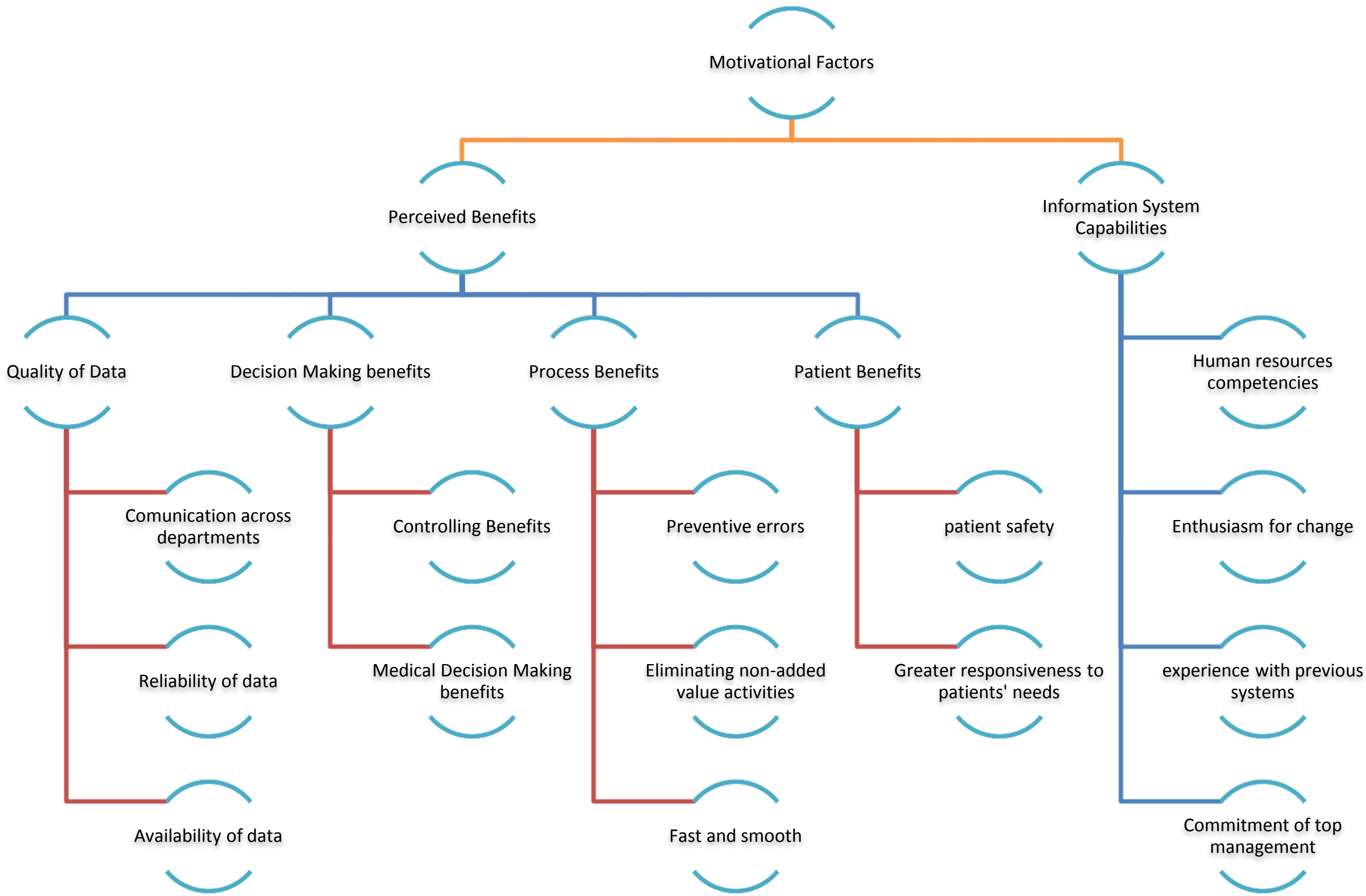
This case achieved the highest level of EMR implementation among all the cases as it achieved level three without PACS. Although it did not have financial support like the first case since it was located in a rural remote area, this case did well in terms of reaping benefits from the EMR system. Benefits obtained from the EMR can be classified into decision-making benefits that come from the quality of data, process benefits in terms of increased speed and fewer errors, and patient benefits in terms of patient safety and responsiveness to patients' needs.

As summarised in Figure 74, and used in the next chapter as basis for the implementation framework, the main perceived reason for this distinguished performance was the clear commitment of top management before, during and after the implementation. This commitment was translated into regular meetings with the users and decision makers to discuss any challenges in the implementation and in carrying out a benefits audit in the post-implementation phase. Furthermore, their commitment was also reflected in the strict rules used to enforce users to comply with the EMR, using a disciplinary system and positive acknowledgments as a "stick and carrot" approach. This top management commitment was accompanied by human resources that were motivated to use the system and had previous experience with similar systems. The human resources in this case were unique and could be distinguished from other cases since a significant proportion of decision makers and staff were from outside the Kingdom and therefore had they used similar systems before in their own countries.

Nevertheless, this case faced challenges like the other cases in terms of IT infrastructure problems, software problems, a lack of internal IT resources, and an inadequate Service Level Agreement. Although these problems were common to all the cases, they were perceived in this case to be serious and, it was felt, if they persisted, this case might be forced to return to a manual system. IT reliability affects business continuity which was not accepted by the key stakeholders of this case.

Figure 74: Motivational versus De-motivational factors in case 3




Motivational Factors
Perceived Benefits
Information System Capabilities
Quality of Data
Decision Making benefits
Process Benefits
Patient Benefits
Human resources competencies
Comunication across departments
Controlling Benefits
Preventive errors
patient safety
Enthusiasm for change
Reliability of data
Medical Decision Making benefits
Eliminating non-added value activities
Greater responsiveness to patients' needs
experience with previous systems
Availability of data
Fast and smooth
Commitment of top management

Chapter Eight: Comparative Analysis: Development of Motivational and De-motivational Factors Framework for Further EMR Implementation

8.1 Introduction

This chapter sheds light on the differences and the similarities between the three cases so that it can be understood why one case was doing better and making more progress in implementing and using EMR while another was not. It is interesting to understand the common motivational and de-motivational factors shared between hospitals in the Eastern Province. Additionally, this chapter explores why there are differences in attitudes, regarding the benefits offered by EMR, and in EMR implementation levels. All the case hospitals were situated in the same province and under the same service provider and so it needs to be asked why differences existed.

In order to answer this question, this chapter firstly reminds the reader about the cases and the level of implementation in each case, as well as providing a summary of the similarities and differences between the cases. A motivational and de-motivational framework, devised by detailing and analysing the similarities and differences between the cases, is presented here. Based on this framework, there are “common” factors that face all hospitals and other “site-varied” factors that are different and controllable by each case. These site-varied factors are believed to answer the “why” question presented in the former paragraph.

8.2 Background of the Cases

This research contrasts three cases of EMR implementation from three hospitals working in the Eastern Province of Saudi Arabia. These cases were similar in some aspects and different in others. They were similar in terms of using the same government rules, quality criteria and being subject to the same ways of governance. However, they were different in their location (urban versus rural), size (490 beds versus only 100 beds), and their international ratio structure (20% international staff to 55% international staff), as shown in Table 55.

The first case was the biggest in size and was situated in the capital city; the government usually made this hospital a priority in terms of funding and commitment (that is, relative to the other cases). In contrast, the third case was the smallest and was located in a rural area; thus, it received the lowest commitment and funding from the government. Case two fell in between the other cases as the number of beds totaled 400 (the first case had 490 and the third 100); this hospital was located in a semi-rural area and consequently received a medium level of commitment and funding.

Table 55: Cases' backgrounds

	Case 1	Case 2	Case 3
Location	Third biggest city	Semi-rural area	Rural area
Size	490 beds	400 beds	100 beds
% of international staff	20%	15%	55%
Government commitment	High	Medium	Low
Level of implementation	Level 1	Level 1	Level 4
Comment on implementation	It was level 4 but regressed back to level 1	Planning and doing their best to be level 2	Level 4 except PACS and implementing some features and components of level 4

Although the first case was the biggest in size and received the highest priority from the government (in terms of funding and commitment), it failed to sustain level 3 or even 2; it was level 4 but now is level 1. Indeed, the government invested a great deal in this case in terms of EMR components; for instance, it was the only case funded to implement the PACS system and SMS reminders. Nevertheless, it did not gain many benefits from using EMR compared to the other cases, as can be seen from the quantitative and qualitative analysis presented later in this chapter.

In contrast, case 3 was the smallest and received the lowest level of priority. Even the government did not want to consider it for implementing EMR. Indeed, without the top management's enthusiasm for implementing EMR by making multiple requests to the government, it would not have been able to obtain the funding to implement the system.

Although there was a lack of commitment and support from the Ministry of Health, this case achieved the highest level of benefits (based on analysis carried out later in this chapter from quantitative and qualitative perspectives) and the highest level of EMR implementation. This case achieved level three and implemented many components of level 4, only requiring PACS to be in level 4. The main restricting factor was the availability of funding as the PACS system was too expensive to be purchased by the internal resources of the hospital.

Between the first and third cases was case 2. The second case faced the same problems as case 3, such as a lack of funds, and some of the problems of case 1. Although financial problems hindered its ability to buy the PACS, this case used its internal resources to develop a cheaper version of PACS albeit of a lower quality. This case is currently planning to achieve level 2 and staff there are working to achieve this level. The following sections identify the common and different motivational and de-motivational factors across the three cases.

8.3 Data Analysis Techniques

This chapter aims to consolidate, contrast and draw conclusions from the previous case studies. Therefore, besides the qualitative analysis methods used in the previous chapters, other techniques were used to find new patterns and thoughts from the quantitative data. The aim was to provide a greater depth of insight in order to examine and compare case studies by identifying the differentiating factors and variances in the perceptions between the cases. After cross-sectional analysis using the qualitative data was carried out, conclusions were drawn. Therefore, in order to test the findings in an objective and quantitative way, quantitative analysis was then used and because the data were non parametric, in order to contrast the cases, the Kruskal-Wallis test (a one-way analysis of variance) was found to be a suitable quantitative technique to use (Field, 2009). Additionally, in order to test the causal relationships that emerged from the qualitative analysis, another quantitative technique, namely regression, was applied. Thus, as illustrated in Table 56, the additional quantitative techniques used in this chapter were the Kruskal-Wallis test, and simple and multiple regressions.

Table 56: Analytical models used in this chapter

Analytic Model	Reason
Kruskal-Wallis Test (a one-way analysis of variance)	To find out whether or not there are significant differences between cases with regard to different questions.
Simple regression	To find the relationships between an independent variable and a dependent variable.
Multiple regression	To find the relationships between multiple independent variables and a dependent variable.

8.4 Analysis of Similarities and Differences between the Cases

The quantitative and qualitative analyses start by showing that there are differences and similarities between the cases. Afterwards, a new framework is developed to explain and detail how these differences and similarities affect motivations to further implement the EMR.

8.4.1 Differences and Similarities from the Qualitative Analysis

Qualitatively, some factors were perceived to be a motivator in all cases while others were perceived to hinder futher implementation for all cases. These factors were called “common” factors as they were roughly equal between the cases and were therefore not believed to be factors that led to differences in EMR implementation levels. Nevertheless, other factors were perceived to be a motivation for one case and a demotivation for another. Therefore, these factors were called “site-varied” factors as they were different from one case to another; therefore, they were believed to be the reason for the variation in EMR implementation levels. As illustrated in Table 57, the “common” and “site-varied ” factors were tabulated and contrasted between cases to shed the light on the key drivers in achieving different levels of EMR implementation.

Table 57: Motivational and de-motivational factors from the qualitative analysis

Classification	Factor	Case 1 (Worst in EMR implementation)	Case 2 (Medium in EMR implementation)	Case 3 (Best in EMR implementation)
Common Motivators	Perception of benefits	High	High	High
	Escaping from manual system	High	High	Medium
Common De-motivators	Technical problems	Medium	Medium	Medium
	Service Level Agreement	Medium	Medium	Medium
	Funding problems	Lack of funding	Lack of funding	Lack of funding
Site-varied	Resistance to change	High (Push change)	Medium	Low (Pull change)
	Top management commitment	Weak	High	Very high
	Training needs	High	Not a factor	Sufficient training
	Involvement	Low	Not a factor	High involvement
	Perceived ease of use	Low	High	High
	Attitude toward the system	Negative	Positive	Positive

*Red: these factors are preventing the case from further EMR implementation (de-motivational factors)

*Green: these factors are motivating the case to implement the EMR further

8.4.2 Differences and Similarities from the Quantitative Analysis

These results are supported by the quantitative analysis, as illustrated in Table 58. Based on the Kruskal-Wallis test for the significance of differences between different samples, there were some factors that were perceived to be similar among the cases whereas other factors were not. For instance, users and decision makers in the three cases believed that EMR decreased medical errors and unnecessary medical tests, and was better than the manual system (what was called earlier ‘escaping from the manual system and gaining benefits of the current system’). The quantitative statements that reflected the dominance of the EMR over the manual system: (e.g “Using EMR systems in the hospital is better than using manual records” and “If had to choose between the electronic medical records and the manual ones, I would chose the electronic”) and that reflected perceptions of decreased medical errors: (e.g. EMR decreases medical errors) were. These were perceived to be similar and there was no evidence to support the notion that there were significant differences between the cases (P-Value<1%).

Nonetheless, there were other benefits that were perceived to be significantly different across the cases (P-Value<0.00), such as the level of productivity and quality achieved through using the EMR, and patient privacy and confidentiality. The level and type of benefits recouped were different due to other factors, such as top management commitment and the level of users’ involvement in the system.

Likewise, as illustrated in Table 58, quantitative analysis was found to agree (by finding a significant differences between cases (p-value<0.00)) with the qualitative analysis regarding the “site-varied” demotivational factors (i.e., those factors that were different in the cases), such as the inadequacy of computers, difficulties with learning and operating the system, lack of involvement, and inadequate training. As addressed before, these “site-varied” factors can be inferred as being key drivers in achieving different levels of EMR implementation.

Table 58: Kruskal-Wallis test (differences between independent non-parametric measures). Report (SPSS - Output) to measure the significant differences between cases regarding different questions in the questionnaire.

Test Statistics[a,b]

	Chi-Square	Asymp. Sig.	Implication*
UA1-EMR is important for me to do my job in an efficient and effective manner	0.164	0.921	Common Factor
UA2-Using EMR systems in the hospital is better than using manual records	1.815	0.404	Common Factor
UA3- Using EMR systems in the hospital is more helpful	2.411	0.3	Common Factor
UA4-If had to choose between the electronic medical records and the manual ones, I would chose the electronic	1.509	0.47	Common Factor
SC1- Computer adequacy	**35.523**	**0**	Site-varied Factor
SC2- Flexibility	**23.231**	**0**	Site-varied Factor
SC3- Easy to learn and operate	**28.114**	**0**	Site-varied Factor
SC4- Stimulating	**32.538**	**0**	Site-varied Factor
SC5- Satisfying	**29.733**	**0**	Site-varied Factor
SC6- Wonderful	**23.915**	**0**	Site-varied Factor
SC7- Increases productivity	**16.493**	**0**	Site-varied Factor
SC8- Increases quality	**11.356**	**0.003**	Site-varied Factor
IoT1- Makes my day easier	3.426	0.18	Common Factor
IoT2- Feeling relaxed while using	3.479	0.176	Common Factor
IoT3- Faster than manual	2.12	0.347	Common Factor
IoT4- Improves staff communication	**16.645**	**0**	Site-varied Factor
IoT5- Improves work efficiency	**7.235**	**0.027**	Common Factor
IoT6- Improve quality of patient care	**10.506**	**0.005**	Site-varied Factor
IoT7- Decreases medical errors	1.027	0.598	Common Factor
IoT8- Decreases number of unnecessary medical tests	4.577	0.101	Common Factor
IoT9- Enhances confidentiality of patient information	**11.804**	**0.003**	Site-varied Factor
IoT10- Increases patient privacy	**11.267**	**0.004**	Site-varied Factor
EC1- Top management commitment	**23.973**	**0**	Site-varied Factor
EC2- Senior managers are helpful	**24.797**	**0**	Site-varied Factor
EC3-Adequate training	**19.629**	**0**	Site-varied Factor
EC4- Computers are adequate in the hospital	**16.118**	**0**	Site-varied Factor
EC5- Users are involved in the developmental process of EMR	**15.655**	**0**	Site-varied Factor

a. Kruskal-Wallis test

b. Grouping Variable: Case

* Significance at 99% → Significant difference means this factor has significantly different scores across cases

The previous analysis showed that the cases were different (e.g. site-varied factors) in some factors and similar in others. On one hand, as summarised in Table 57 in the qualitative analysis, they were different with regard to: the level of resistance to change; top management commitment; training needs; involvement; perception of the ease of use; and attitudes towards the system. Thus, from the quantitative analysis (Table 58), there were differences in the outcomes in the kinds and levels of benefits, and attitudes towards the system, for example. On the other hand, they were similar, as can be seen in the quantitative analysis, with respect to other factors, such as escaping from the manual system (as tabulated in Table 58), technical problems, service level agreement, and funding problems, as shown in Table 57.

Based on the aforementioned quantitative and qualitative distinctions between the "common" and "site-varied" factors, the framework for motivational and demotivational factors for further implementation, as illustrated in Figure 75, consists of: uncontrollable common motivational and demotivational factors, site-varied controllable factors, site-varied intermediate factors, and site-varied results.

The external black circle in Figure 75 represents the external common motivational and de-motivational factors. These factors are related to the external contextual factors imposed on the hospitals by the government; the EMR software and its provider, such as the details of Service Level Agreements (SLA) which govern the relationship between the vendor and the hospital; the level of support and commitment in terms of funding; and the follow-up of the EMR implementation in each hospital.

These common factors affected all cases and they were out of the control of the hospitals' management. However, other factors were controlled by the hospitals' management; these are called "controllable site-varied factors", as illustrated in the second dark grey circle of Figure 75.

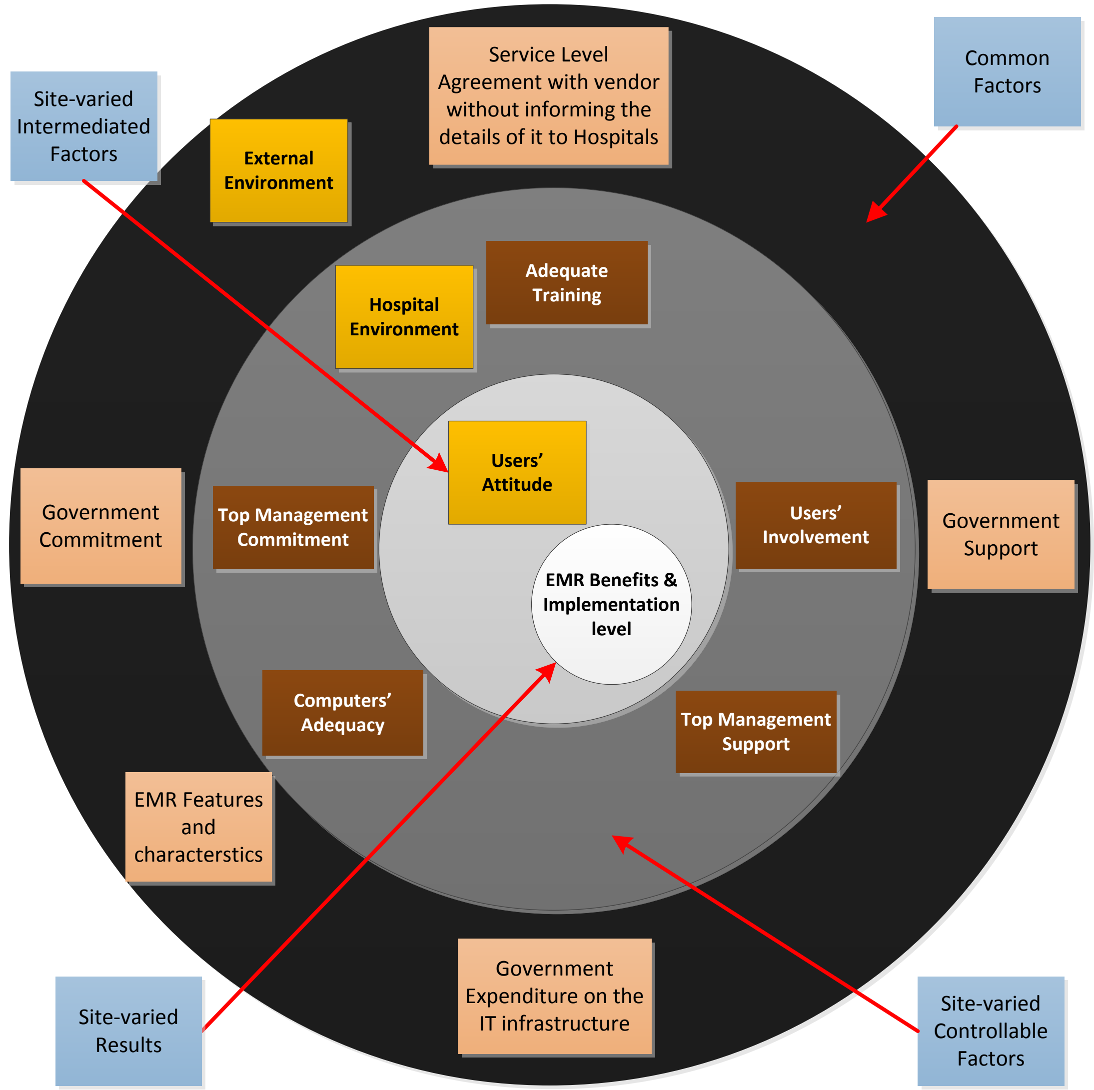


Figure 75: Framework for motivational and de-motivational factors for further EMR implementation in Eastern Saudi Arabian Hospitals

These controllable site-varied factors affected the organisational attitude toward the EMR and thus, the realisation of its benefits (the smallest circle in that figure); this, in turn, affected the motivation to further implement it, as the following sections reveal. These controllable site-varied factors were: top management commitment by following up the implementation and using techniques and methodologies for change management; top management support by listening and reacting to users' needs; making recommendations about the system and doing their best to address these points; providing adequate training to the users; involving users; and ensuring that computers were adequate in terms of the existence of a suitable IT infrastructure.

These controllable site-varied factors were perceived to have an impact on the 'intermediate site-variable factors'. Intermediate site-varied factors are the attitude of users toward the EMR implementation (the yellow box in the inner circle). For example, as analysed and explained later in this chapter, the more training received by users (a site-varied controllable factor), the more positive the attitude toward the system because of the perception of ease of use. Likewise, a user feeling "satisfied" is a function of controllable site-varied factors such as the "adequacy of computers" and the level to which he/she is involved in the implementation.

Nevertheless, not all attitudes were similar across cases because of the controllable site-varied factors. There were shared positive attitudes toward the system because all three hospitals used the same EMR with the same interface characterstics and the same vendor. These attitudes were sometimes positive, such as percieving it to be a way of escaping from the manual system, and sometimes negative, such as viewing the system as unreliable due to the lack of responsiveness of the service provider because of an inappropriate SLA.

Finally, all common and site-varied controllable differentitated factors not only affected attitudes they also affected, either directly or indirectly through these attitudes, the site-varied results, such as the level of realisation of benefits and the level of EMR implementation (the smallest inner circle). Like the attitudes, there were benefits that were realised regardless of the site-varied factors. These benefits, such as decreasing medical errors by reducing the occurrence of illegible handwriting, emerged due to the existence of the same system in the different cases. Nonetheless, other benefits were achieved in one case and not in the others, such as increasing the quality of patient care, and securing the privacy and confidentiality of patients' profiles and transactions.

It could be claimed that the benefits were differentiated because of the level of implementation, not because of the controllable and intermediate site-varied factors. The answer to this argument is that the first case had more features than case 2 and case 3. It had more advanced features of PACS which were not available to any of the other cases. Additionally, it currently has SMS reminders which are expected to enhance patients' quality of care. Furthermore, case 1 had already achieved level four but then regressed and stopped using many EMR features, thus going back again to level 1. This is clear evidence to support the idea that the main drivers are not a feature; rather, they are the controllable and intermediated site-varied factors.

The following sections explain and support, using quantitative and qualitative evidence, the motivational and de-motivational framework presented in Figure 75. Firstly, the factors are examined that are perceived similar among the all cases to explain the common motivational and de-motivational factors that affected all cases in similar way. Secondly, those factors that were perceived differently across the cases are presented to uncover the site-varied factors that affected the final results: the benefits that were realised and the level of EMR implementation.

8.5.1 Factors where Perceptions were Similar among the Three Case Studies (Common Motivational and Demotivational Factors)

There were common motivational and de-motivational factors that affected all cases with regard to further implementing the system; these may have stopped them from going further or may even have meant they degraded the EMR system. Common motivational factors related to perceptions of how EMR had changed the way users did their jobs, making their lives easier than before. In other words, there was panic about going back to a manual system, as this was a problem for the users because, for example, it involved huge amounts of bulky documents. This usually stemmed from perceptions of the common current benefits of EMR, such as decreasing medical errors and decreasing unnecessary medical tests.

On the other hand, there were restraining factors that limited the desire to implement the system further or that even caused users to consider degrading it, as happened with case 1 which down-graded from level four to level one. De-motivational factors firstly concerned technical problems. Computer frustrations made the system unreliable; the system might shut down and freeze on many occasions. These shared problems made the users feel negatively towards the system. This problem was exaggerated as there was no proper Service Level Agreement (SLA) between the hospital and the vendor to determine the quality of the IT services provided, such as time differences between two failures or the time taken to resolve incidents, etc. A factor in these technical problems concerned funding as there were insufficient funds to buy new computers or new components and features of EMR. This issue frustrated top managers as they were unable to go further with the development of EMR because the problem caused a bottleneck (this was especially so for case 3).

As illustrated in Figure 76, common motivational factors affected the users' and decision makers' attitudes toward the EMR and therefore encouraged this case to further implement the system or at least keep using the system. Nevertheless, the common de-motivational factors frustrated the users and pushed them to stop using it, especially when technical problems occurred frequently without them being able to fix them within a short time period. Indeed, case 1 decided to stop using many systems of EMR due to these technical problems which had made the users very frustrated.

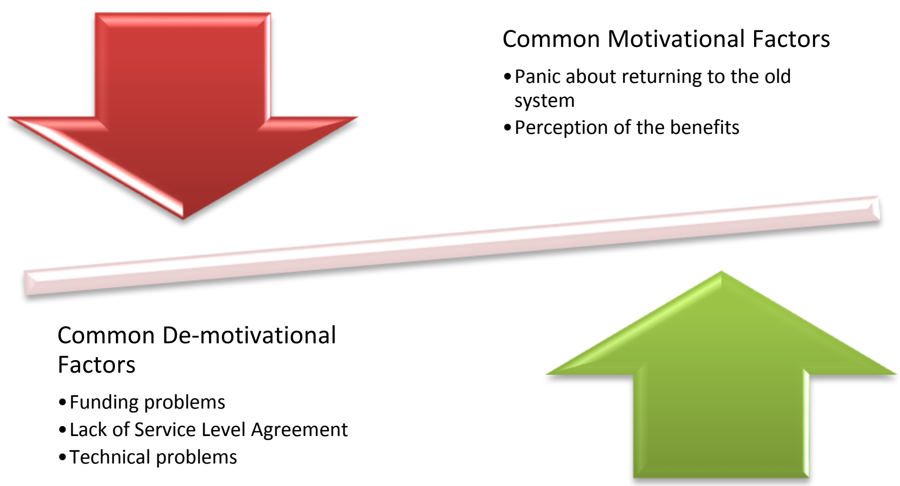


Figure 76: Common motivational and de-motivational factors

8.5.1.1 Common motivational factors

Perceptions regarding the benefits of the system and the value of escaping from the manual one were common motivators in all three cases. Users and decision makers in the three cases perceived some benefits but they also panicked about returning to the manual system. However, some of these perceptions were not similar in all cases; these are discussed later in the "site-varied factors" section.

All of the hospitals perceived that EMR was better than the manual system and they did not want to go back to manual work. Qualitatively, there were shared positive attitudes towards EMR as an information technology to overcome the previous problems found when using a manual system. The reasons for escaping from the manual system could be different and due to a variety of factors, such as the size of the hospital and consequently the number of patients, or for similar reasons, such as illegible handwriting which led to medical errors, and the availability of data at the right time to enhance decision-making processes.

For instance, case study one, which interacted with a huge number of patients, usually faced the problem of records being "bulky to store", as explained in its chapter.

> *"Paper-based medical records became bulky and required a larger space for filing. There was loss of medical records, loss of laboratory and radiology reports."* ID001

The huge bulky files made it impossible for staff to access the data easily and wisely:

> *"Doctors suffered much from the non-availability of the films and reports when needed during patient care. This affected the continuity of patient care and increased the cost. Repeating X-rays also is hazardous to patients and staff."* IQ001

Likewise, case 2, due to its size (400 beds), which was smaller than case 1 (490 beds), faced a problem because of the large number of patients. This led to an inability to manage records easily so that they could be used in a timely fashion:

> *"In my opinion there were two main problems that we faced with paper-based medical records. The first problem was the unavailability of patients' health records when needed by the medical staff. The second one was the difficulty in accessing patients' clinical information. Other problems include: loss of laboratory reports, accumulation of huge numbers of records."* IQ005

This large number did not help the staff to take correct action in a timely manner:

> *"I can add that now we have better control over medications in the hospital. Every medicine received by patients is on the system. Before we didn't have access to this information."* IQ002.

Although case 3 was about a quarter of the size of case 2, and a fifth of the size of case 1 in terms of beds (100 beds), they faced the same feeling of panic with regard to going back to the manual system. However, the reason for this was rather different. This case did not have the problem of having bulky files to store; rather, it faced other problems (which were shared with other cases) such as medical errors occurring due to illegible handwriting:

> *"In other words the IT can help minimise adverse drug events and thus improve patient safety. As you know most adverse incidents in the hospital are related to medication errors."* IK004

and the speed of the current process due to the manual sharing of data across departments:

> *"Recording and the flow of information is easier and faster now. Doctors are keen to enter their notes for each episode or encounter in time to avoid any delay in work flow."* IK005

Likewise, cases 1 and 2 shared the same reasons for preferring the EMR to the manual system, such as decreasing errors and unnecessary medical errors:

> *"There are many benefits, you know. It is difficult to list them all here. But I can assure you that the number of medication errors has decreased."* ID002

> *"It enhances patient safety through the elimination of medical errors as a result of poor handwriting."* IQ006

Statistics support the same findings. As illustrated in Table 59, the average response of all respondents in the three cases was more than 4.5 (out of 5) for all questions relating to a preferrence for the current EMR system over manual work. The standard deviation in this regard was less than 0.8 which means that all respondents' responses were very close to each other and without significant differences in terms of these questions. Besides the Kruskal-Wallis test conducted formerly, this is further evidence to support the shared perception of the users towards “panicking” about returning the old system.

Table 59: General perceptions towards preferring EMR to using the manual system

Descriptive Statistics			
	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
Using electronic medical record systems in the hospital is important for me to do my job in an efficient and effective manner	228	4.4956	.66702
Using electronic medical record systems in the hospital is better than using manual records	228	4.5132	.70542
Using electronic medical record systems in the hospital is more helpful	228	4.5658	.58623
If had to chose between the electronic medical record and the manual systems, I would chose the electronic one	228	4.5395	.69182
Valid N (listwise)	228		

However, statistically, these shared benefits did not have the same impact as the “preferring EMR to the manual system”. As illustrated in

Table 60, the average of perceiving EMR as a way to decrease medical errors and overcome unneccessary medical tests was below 3.8 (compared to a minimum of 4.5 for questions concerning ‘prefering EMR to a manual system’). This significant difference (P<0.00) between these two motivations (using ANOVA test) indicates that there are other factors that contribute to the preferrence for EMR. Regardless of this comparison, the standard deviation was rather higher in these questions than in the preference questions (the standard deviation is about 1). This does not mean that the cases were different since this was tested before and no significance differences were found between the cases; however, it means that there is no strong or clear universal acceptance that EMR decreases unnecessary medical tests and errors.

Table 60: Common EMR benefits

Descriptive Statistics			
	N	Mean	Std. Deviation
	Statistic	Statistic	Statistic
Decreases medical errors	228	3.842	.9580
Decreases the number of unnecessary medical tests	228	3.732	1.0675
Valid N (listwise)*	228		

*the total sample in the three cases

8.5.1.2 Common de-motivational factors

Since the three cases were working under the same government, they faced the same uncontrollable factors; these uncontrollable factors of limited funding, technical problems and the lack of a Service Level Agreement, were perceived to be hindering further implementation in the three cases. Although the funding allocation to the first case was higher than to the other cases (it had already received sufficient funds to implement level 4 while other cases were still struggling to afford the PACS), blaming insufficient funds was decisive and clear. Likewise, in the other two cases, the same perception prevailed.

These shared de-motivational factors are believed by the researcher, however, not to be a significant factor for reasons that are two-dimensional. From the first theoretical dimension, although the existence of these factors is clear, there were variations in the level of implementation between the three cases, which means that these factors are not predictors of the level of implementation. From a quantitative dimension, there is no evidence to support a significant relationship between the level of implementation and these factors. This does not mean that there is no relationship; rather, it means that, in this study, it is not possible to show a relationship as the three cases were similar in terms of these factors but they cannot be used as predictors for any other site-varied factors.

8.5.1.2.1 Technical problems

All cases faced the same technical problems which were related, not only to computer problems such as system shutdowns, freezing and other technical problems, but also to software related problems. Although, as explained later, the adequacy of computers was different from case to case, all these cases faced the same level of technical pressure. However, the impact of this might be different based on how the top management used controllable factors to manage and handle these problems. Thus, it can be clearly seen that the reflection of the technical problems on the users was relatively high in case 1 and low in case 3.

> *"We frequently lose information due to system shutdown or malfunction. (Pause), (then loudly), the system has not been thoroughly evaluated before implementation."* ID001

> *"This system is full of defects and there is frequent malfunction and shutdowns. We lose information because there is no good backup system."* ID002

Indeed, the top management was very passive about these problems as it just asked users to "adapt" to these problems:

> *"They told us to adapt to the program... to adapt with all the system defects."* QFG002- P27

This negative approach in dealing with the system exaggerated the impact of the problems:

> *"When the system shuts down we wait for days for the problem to be fixed."* QFG002-P28

Furthermore, the top management in general, and IT management in particular, had not adopted any reactive or proactive strategies to handle the problem. There was not even a back-up strategy as a reactive strategy to the problems:

> *"There must be an effective backup system because the system hangs and freezes delaying our work and reducing our productivity."* QFG001-P17

Therefore, users were frustrated and disappointed with the system:

> *"It is not meeting our needs. There are many problems... computers are slow, frequent shutdowns, no backup system, no maintenance."* DFG001-P5

The same problem was faced by case 3:

> *"I agree with my colleague that there are many technical problems which need to be addressed and solved."* KFG001- P30

However, these perceptions of technical problems were different from those in case 1, as there they were considered important but not as a barrier to further EMR implementation:

> *"I think the system is relatively successful. I said relatively because there are daily problems with the system. Most of these problems are technical and if solved will definitely contribute to its success."* KFG001- P32

In summary, cases faced the same technical problems that were caused because of the unreliability of the system. Nevertheless, the way of dealing with this problem could either escalate or control the difficulty. Thus, its consequences might affect the users and decision makers' attitudes toward the EMR and thus affect any decision regarding further implementation.

8.5.1.2.2 Service Level Agreement

Another prevailing problem in all cases was the content of the Service Level Agreement (SLA). Nothing was written in the SLA about the level of commitment of the vendor in delivering a proper IT service when the commitment and support of the vendor to solve technical issues in a timely manner is a vital issue for EMR success.

> *"We have concerns about the infrastructure, the network, backup systems, and after sale services. Without strong support regarding these issues, the EMR will not work properly and may even fail."* IQ005

The vendor in the current SLA was not obliged to fix a problem in a specific number of days. Therefore, this problem escalated in the cases when there was a large number of technical problems. The main problem was usually with the bugs that popped up in the system and there was an inability to handle this problem in a timely fashion:

> *"You know the new technology brought new problems to our hospital. If the vendor is not willing to solve these problems, it means that we have to live with all the defects in the software. When the system shuts down, everything stops. After-sales services are very poor. That is why we are suffering. I think the hospital should be aware of all the items in the contract with the vendor."* IQ007

The same problem was faced by case 3:

> *"Major problems can only be solved by the company but it is very far away from here and their response is very slow and sometimes they do not respond at all."* KFG001-P33

The problem of poor responsiveness could be because the hospital was located so far away from the vendor's headquarters. However, even though case one was located in the capital city near the vendor, it faced the same problems:

> *"Maintenance is not proper, even their telephone numbers are not working and we have to call their mobiles. If you have a defect you have to wait for days for repair."* DFG001-P3

Therefore, the general attitude toward the relationship with the vendor was:

> *"The vendor didn't provide good support."* QFG001-P21

8.5.1.2.3 Funding problems

Funding problems were one of the major restraining problems for cases 2 and 3 since they received the lowest priority in the government budget because they were not located in the capital city, unlike case 1. Thus, only cases 2 and 3 faced funding problems but each of them had a different strategy to deal with it. Case 2 faced this problem by developing its PACS system internally using its own internal resources. Although this system was not as good as the outsourced PACS, it worked and satisfied the users to a certain extent. This was not so with case 3 as it was not able to do the same. Thus, there was no PACS system in case 3.

Funding problems were not only related to the existence of EMR components but also to the process of gaining benefits from the system in terms of financial support after implementation:

> *"The MoH has purchased this system for our hospital. But, I don't think they are providing any financial support to the implementation process of the system. The MoH contracted with this vendor to install the EMR software in our organization."* IQ007

Additionally, funding problems also affected the relationship with the vendor in case 2:

> *"The vendor stopped the whole system for many days because he had not received all his money from the MoH."* IQ002

The same problem was reported for case 3:

> *"The major changes we want in the system are very expensive to the company and I believe that this is the main reason why they don't respond to all suggestions. The company apologizes about not making some modifications because they say these modifications are not within their contract with MoH."* KFG001-P36

Therefore, it was suggested that there should be a separate budget for EMR in order to reap its expected benefits:

> *"A separate budget for the EMR. I think all these factors should be and can be resolved to make EMR implementation successful."* IQ007

Although cases 2 & 3 faced financial problems which were considered to be a factor hindering them from going further, case 1, which did not face this problem at all, was the lowest in terms of EMR implementation (level 1 after being level 4) while case 3 was the highest (level 4 if it is able to buy PACS). Thus, this is not considered a key driving factor for achieving EMR level 3 or 4. However, it will constrain any hospital trying to break into level 4 as PACS is too expensive to be bought using the hospital's internal resources.

8.5.1.3 Factors where perceptions differed between the case studies (site-varied factors)

Although the common motivational and de-motivational factors are believed to affect the overall EMR implementation level in these three cases, these cases achieved different levels of EMR implementation. This indicates that the site-varied controllable factors were the key for achieving various levels of EMR implementation in the three cases.

Site-varied factors are classified into three main groups: independent factors, intermediating factors and results-dependent factors. Independent factors are the controllable environmental factors that are manipulated by top management; these are top management support and commitment, training, computer adequacy, and involving users' in the implementation process. Intermediating factors include users' attitudes toward the system. Like other factors, there are common attitudes toward the EMR, as explained earlier. However, the focus in this section is the attitudes that were different across departments. Finally, the dependent factors are the benefits realised from the existing EMR system.

8.5.3.2.1 Differences in perceptions regarding controllable factors (controllable site-varied factors)

Site-varied factors are perceived to be different across three cases. These factors are: top management commitment and support, adequacy of training, computer adequacy, and users' involvement in the implementation process.

8.5.3.2.1.1 Top management commitment and support

Qualitative analysis found that top management commitment was widely different from case to case. Indeed, in contrast to the top management in case three, which showed great commitment to EMR, some top managers and directors were not committed to EMR at all, as in case 1:

> *"Honestly speaking? I cannot see any type of visible support."* ID002

This is because some members of top management believed that EMR was not a strategic issue:

> *"Some department heads don't want electronic health records in this hospital. They simply believe that EMR is just waste of time."* ID003

Thus, this lack of belief in the EMR was reflected in the weak commitment of the directors or users:

> *"There is no strong support from the top management. Many doctors are not using the electronic prescription, but no one takes action against them."* ID004

Indeed, it was asserted in this case (case 1) that support and commitment from top management was actually a vital factor that could either aid or hinder EMR implementation:

> *"If all top management and department heads support the implementation of EMR they can do a lot of things to facilitate the implementation of EMR."* ID001

Case 2 was in the middle of the three cases; there, the staff believed that there was commitment and support but not at a sufficiently high level:

> *"I can see there is support but is far beyond the expectations."* IQ002

> *"Support is not up to the expected level. I can see it is only 50% of what is needed. Hospital management support is very critical for the success of the EMR system."* IQ006

In case three, the view was different from all the other cases. Top management were very committed and supportive of EMR implementation:

> *"I can say the hospital leaders are very committed and supportive to the EMR."* IK003

> *"The previous hospital director played a role in making the implementation successful. He used to personally follow-up all actions and processes in all departments. He was very committed to the EMR because he was the one who initiated the idea in this hospital."* IK002

This commitment was reflected in the day-to-day care and follow-up of the EMR implementation:

> *"There were regular meetings between the hospital director and head departments to discuss the implementation process and solve problems encountered during the process."* IK001

Quantitative analysis supports the qualitative findings, as illustrated the ANOVA analysis in the SPSS report (Figure77). As illustrated in Figure 78, in Case 3 (the case that achieved the highest level of EMR across the three cases) the highest top management commitment and support existed. On the other hand, in the first case, which achieved the lowest level of EMR of the cases in this study, was found to be the lowest in terms of top management commitment. This is a strong indication that top management commitment and support are major determining factors of the level of EMR implementation.

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
EC1- Top management commitment	25.189	2	12.594	10.828	.000
	261.702	225	1.163		
	286.890	227			
EC2- Senior managers are helpful	20.199	2	10.100	10.418	.000
	218.130	225	.969		
	238.329	227			

Figure77 : ANOVA analysis of top management commitment

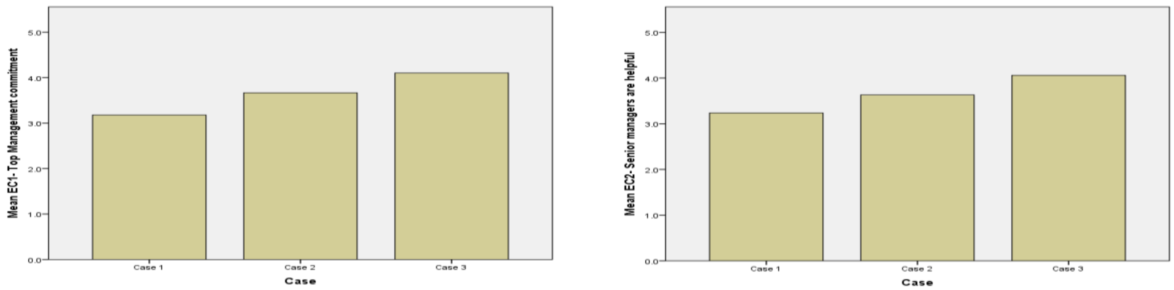


Figure 78:Top management commitment and support towards EMR implementation and use

8.5.3.2.1.2 Training

The quantity and quality of training varied significantly among the cases. For instance, although case one was found to have a few days' training, case three trained their staff substantially. Indeed, directors in interviews believed that they had not received sufficient training because of the lack of top management support:

> *"There is no visible support, no adequate training director."* ID004

The internal medicine on case one said:

> *"Take me as an example, they trained me for one day on a very huge system and they expected me to know everything about the EMR and implement it in my daily routine work."* ID006

Indeed, this was perceived to be a restraining factor in realising the expected benefits of EMR:

> "*It is important to provide effective training for all staff to be able to realize the desired outcomes from the EMR."* ID001

In an example of better training, case 2, users received more than a few days' training:

> *"They installed the software and started training people in all shifts to use the system. In one month we were all trained and given a username and password."* QFG002-P24

However, this training was not conducted properly from the users' perspective and it was not carried out in the best way (with hands-on experience):

> *"They didn't even ask about our training need."* QFG002-P29

> *"There were lectures. They conducted some training courses and lectures."* QFG002-P26

Perhaps these are the main problems with regard to training or there may be others, such as being in a rush to be trained, and/or no proper commitment from the users and top management. In all cases, however, all of these factors were reflected in "insufficient" time to attend the training:

> *"We cannot attend training courses. We are so busy. We have too many patients and at the same time a shortage of staff."* QFG 002-P27

Finally, the training was not for all staff and users:

> *"They provided training and some doctors benefited from this, but some others didn't due to their limited computer knowledge and skills*." QFG001-P20

Contrary to the first and second cases, the third case devoted more resources and efforts to EMR. The duration of the training was not the main or only issue; it was also the nature of the training. In case three, each director (head of department) trained his/her own employees him/herself and followed this up until employees became skillful in using the system, as illustrated in the Nursing Director's words:

> *"My role is to facilitate the training of nurses and encourage them to implement the program. I help through nursing education in minimizing nurses' resistance to the new technology."* IK003

Quantitatively, this issue of receiving different levels of training, at least from the perspective of the users, was verified and found to be true. Based on the ANOVA analysis in Figure79 , users in the three cases received significantly different training. As graphically represented in Figure 80, Case 1, which achieved the lowest level of EMR and which had less top management support for the system, was found to have scored lowest in terms of the sufficiency of training delivered to users. However, case 3 scored the highest, as qualitative analysis revealed. Since case 3 achieved the highest level of EMR while case 1 was the lowest, it can be extrapolated from this that the adequacy of training is one of the motivational factors for implementing EMR. However, a logical relationship is still missing in terms of intermediate factors to connect the adequacy of training and EMR implementation.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
EC3-Adequate training	23.122	2	11.561	9.516	.000
	273.347	225	1.215		
	296.469	227			

Figure79 : ANOVA analysis for adequacy of training

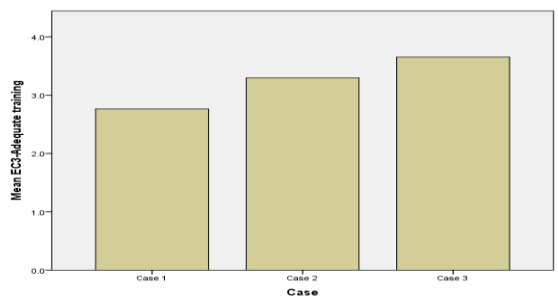


Figure 80: Adequate training

8.5.3.2.1.3 Computers are adequate

Another factor perceived to be different among the cases was the adequacy of the computers or the IT infrastructure. Although this factor was determined only by the government's budget devoted to each case, and case 1 was allocated the most because of its location in the capital city, it was found, both quantitatively and qualitatively, that users and directors there blamed the infrastructure more than in the other cases. However, case three received the lowest budget for EMR implementation because it was located in a rural area. One interpretation of this phenomenon could be the management of the IT resources or it could relate to the number of users relative to the budget as in case 3;

however, this was not so with case 1. Indeed, there is no clear evidence to explain this paradox.

From a qualitative perspective, as explained in this case's chapter, there were IT infrastructure problems that made users frustrated and disappointed. Additionally, the lack of computers caused nurses to queue to carry out any computerised task. Furthermore, computers were not available in all departments and locations; this restricted the use of the system across the hospital and/or in conjunction with other hospitals:

> *"They need to provide adequate number of computers at all locations in the hospital."* ID005

> *"There are too many challenges, like, for example, the inadequate number of computers."* ID006

The same problem was reflected qualitatively, but at a lower level in the quantitative measure, in case 2. The main problem in this case was not the unreliable IT infrastructure, as in case 3, it was the number of computers relative to the number of users:

> *"They haven't even provided enough computers for the staff."*QFG002-P27

> *"All units have this problem of a shortage in computers."* QFG002-P23

> *"The infrastructure isn't adequate and is hindering the implementation of the EMR. I mean especially the lack of computers and well equipped training areas."* IQ005

> *"Other concerns are about the shortage of computers and the lack of effective training."* IQ007

According to case 2, many complained about the lack of computers. One of them even stated clearly that this was a restraining factor in implementing the system:

> *"The infrastructure is very important. They should provide adequate computers and appropriate training facilities."* QFG001-P18

The third case faced the same problem. They had old computers which were insufficient in number for all users. However, top management was actively requesting the government to support them by providing more computers. Frustratingly, the government sent them old computers:

> *"They brought us some computers from another hospital but they are too old and slow."* IK002

In fact, not many talked about the problem of infrastructure. It was not perceived to be a critical factor in this case.

The quantitative data showed what was also illustrated in the ANOVA analysis shown in Figure 81. They perceived that their computers were adequate so far. Furthermore, respondents in case 1, as shown in Figure 82, were the least satisfied with the adequacy of their computers whereas case two participants fell in between.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
SC1- Computer adequacy	46.840	2	23.420	20.789	.000
	253.475	225	1.127		
	300.316	227			
EC4- Computers are adequate in the hospital	27.512	2	13.756	8.406	.000
	368.220	225	1.637		
	395.732	227			

Figure 81: ANOVA analysis for computer adequacy

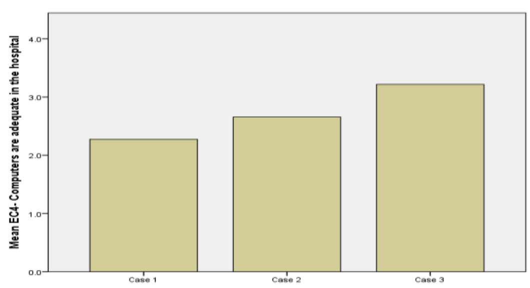


Figure 82: Computer adequacy

8.5.3.2.1.4 Users' involvement

Users' involvement is perceived to be one of key factors that differentiated between the cases in terms of high and low levels of EMR implementation. The top management in case 1 was not interested in the system and its strategic benefits; this affected everything after that. As has been seen before, there was insufficient training, computer problems without any top management intervention to address or to solve them, and users were not involved in the implementation process. Indeed, users in none of the cases were involved in selecting the vendor or writing the SLA agreement with the vendors because this was out of their control, as shown earlier in the section on common de-motivating factors.

However, as with the problems concerning the adequacy of computers, each case dealt with this uncontrollable factor in a unique and different way. For instance, EMR implementation in case 3 was called “Pull implementation” in its chapter, as both the top management and users requested its implementation. As explained before, the government had not selected case 3 for implementing EMR because of its location in a rural area. However, after continuous requests, and a visit by a government committee that met staff and users, the government found a high readiness and need to implement the EMR.

Conversely, case 1 was selected by the government and the government tried to push them to implement more EMR but this did not happen. Even case one, as explained before, had achieved level four but it stopped using many modules and went back to level 1. Users were not involved at any level of the development since the top management was not involved.

As illustrated in Figure 84, the quantitative analysis supports these results, as users in case three scored significantly higher than those in case one in terms of the level of involvement ($P<0.00$) (ANOVA test, Figure83). This indicates that involving users in the implementation stage could be a driver for successful EMR implementation and could help to achieve a faster pace in terms of the system’s implementation.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
EC5- Users are involved in the developmental process of EMR	26.159	2	13.079	9.301	.000
	316.420	225	1.406		
	342.579	227			

Figure83 :ANOVA analysis for users' involvement

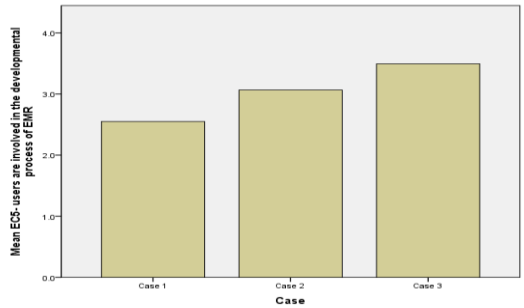


Figure 84: Users' involvement in EMR implementation

In summary, as respondents from cases one and two (which lacked user involvement) confessed, this lack of involvement was one of the key restraining factors for change in general and the successful implementation of EMR in terms of benefits.

From case 1:

> *"Doctors and nurses should be involved in designing the implementation process and planning the transition in known stages according to international models."* ID004

From case 2:

> *"Honestly, involving the users is a very critical issue, in my opinion, you know. Users must be involved in selecting the programme that satisfies their needs.*" QFG002-P27

8.5.3.2.2 Differing attitudes to EMR between sites (intermediate site-factors)

From among those questions when examining attitudes towards EMR, four were selected as being different among the cases: namely, the system being easy to learn and operate, stimulating, satisfying and wonderful. "Easy to learn" can be understood in terms of users' readiness for the system.

8.5.3.2.2.1 Easy to learn and operate

Cases did not share the same point of view towards the system with regard to this issue. Case one believed it was quite difficult and complicated; case two believed it was complex but not very; case three believed that it was easy to learn and operate.

"I myself, I am not satisfied with this programme." DFG001-P4

"The system is not friendly." DFG001-P4

Likewise, the complaints were roughly the same from case 2:

"I think our programme is more complicated compared to other hospitals." IQ006

"There are many complaints from departments that the system is complicated and unfriendly." IQ007

Quantitative analysis supports the qualitative arguments in term of cases being significantly different, as can be seen in the ANOVA analysis in Figure85 . Moreover, the graphic representation clarifies how the average scores were distributed among the cases, as illustrated in Figure 86. This could be an indication that attitudes toward the system, in terms of ease of learning and operating, could be a factor affecting the level of EMR implementation.

ANOVA

	Sum of Squares	Df	Mean Square	F	Sig.
SC3- Easy to learn and operate	21.166	2	10.583	14.044	.000
	169.553	225	.754		
	190.719	227			

Figure85 : ANOVA analysis for easy to learn and operate

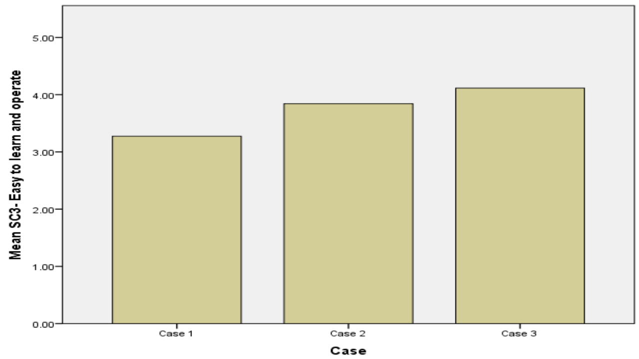


Figure 86: Easy to learn and operate

Since, as the framework previously presented in this chapter showed, this attitude was mainly affected by “hospital environment factors” (especially the controllable ones), it is proposed that “adequate training” is the main driver of this attitude. In other words, the greater the level of training, the greater is the feeling of it being easy to learn and operate. After testing this relationship by simple linear regression among all the respondents in three cases, it was found that this relationship had a p-value of less than 1% and (R=33.3%), as shown in Table 61.

Table 61: Regression analysis (SPSS output) - the impact of "Adequate Training" on "Easy to learn and operate"

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
Adequate training	.267	.050	.333	5.304	.000

8.5.3.2.2.2 Satisfying, Wonderful and Stimulating

Shared reasons for users being unhappy with the system were due to many factors such as technical problems, as stated earlier. Nevertheless, the cases varied in the level of unhappiness expressed.

Case 1:

> *“It is not meeting our needs. There are many problems...computers are slow, frequent shutdowns, no backup system, no maintenance.”* DFG001-P5

Case 2:

> *"The system itself is not trustworthy because we always have the fear that all the information will be lost. The system hangs and freezes."* IQ002

Case 3:

> *"The programme itself brought new problems such as hanging, freezing and complete shutdown."* IK006

Therefore, it is proposed that the level of perceived computer adequacy affects perceptions regarding the whole system being "wonderful". Therefore, this relationship was tested quantitatively using regression analysis. The results suggest that, as summarized in Table 62, there is a significant relationship between the two variables with beta = 0.396 (p-value<0.00). Therefore, managing perceptions with regard to computer adequacy could lead to more positive attitudes towards the system.

Table 62: Regression analysis for the impact of computer adequacy and feeling the system is wonderful (SPSS output)

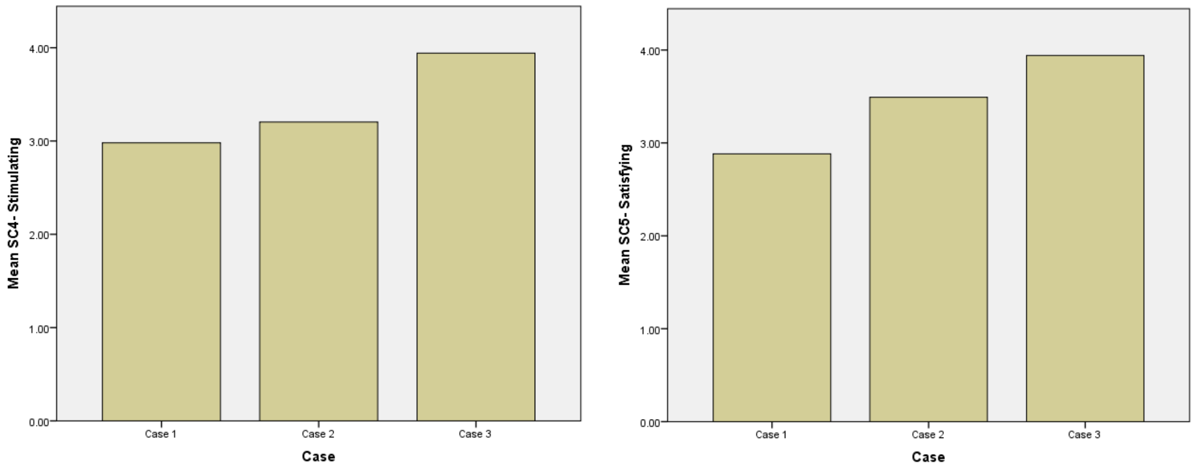
Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
EC4- Computers are adequate in the hospital	.396	.050	.470	7.999	.000

Contrasting the three cases quantitatively, a significance difference was found between the three cases in terms of the system being thought to be "satisfying", "wonderful" and "stimulating", as shown previously. A graphical representation shows

Figure 87: Attitudes toward EMR in the cases

the differences in the averages, with case 3 showing the highest levels in all feelings and with case 1 showing the lowest, as illustrated in Figure 87.



8.5.3.2.3 Perceptions of benefits that differed between case study sites (site-varied benefits)

Among all the benefits of EMR, six main ones were perceived quantitatively as being different among the cases. These benefits can be divided into patient-related and organisation-related benefits. Patient-related benefits included such perceived advantages as improved quality of patient care, and the confidentiality and privacy of patients' records and transactions. Organisation-related benefits were advantages perceived by the employees in terms of organisational processes, such as improving quality, productivity and staff communication. All these perceived benefits were illustrated in the qualitative data obtained. However, by using qualitative analysis, it is difficult to measure the level to which these benefits are actually recouped. Therefore, quantitative analysis of the questionnaire is helpful in this regard.

8.5.3.2.3.1 Patients' benefits

As explained in earlier chapters, perceptions concerning patient benefits from EMR were shared in all cases. However, through a quantitative analysis of the questionnaire via parametric and non-parametric comparisons it was found that the level of achievement was significantly different from case to case.

8.5.3.2.3.1.1 Quality of patient care

Quantitatively, as shown in Figure 89, perceptions regarding enhancements in the quality of patient care due to EMR implementation were significantly different from case to case (as seen in the ANOVA analysis in Figure88 , especially between case 3 and case 1 (case 1 scored less than 3.8 and case three scored 4.3). This enhancement is proposed as an output of the main site-varied factors (drivers): top management commitment and support, adequate training, computer adequacy, and users' involvement in the implementation.

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
IoT6- Improved quality of patient care	8.838	2	4.419	6.649	.002
	148.880	224	.665		
	157.718	226			

Figure88 :ANOVA analysis for improvement in quality of patient care

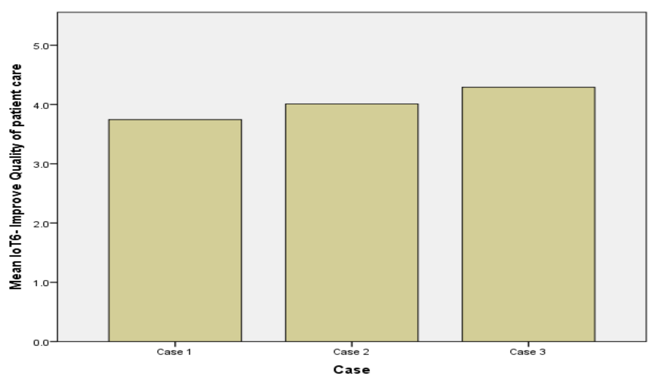


Figure 89: Differences in recouping benefits regarding quality of patient care from EMR implementation

Therefore, after testing five drivers using multiple regression analysis, with regard to enhancing the quality of patient care through the EMR system, as illustrated in Table 63, there was no evidence to support the notion that "Top management commitment" affected the quality of patient care because its p-value was higher than 5% (51.2%). As seen in the multiple regression analysis below, other factors were significant since their p-value were less than 5%. However, "adequate training "had a negative beta that is against the logic and so this was removed from the analysis.

Therefore, based on this analysis in Table 63, the users' perception of the ability of EMR to improve the quality of patient care was associated significantly (p-value < 5%) with a perception of top management support, a perception of computer adequacy, and users' perception of being involved in implementation. In other words, it can be extrapolated that EMR can affect the quality of patient care when the users find support from top management, feel they are being involved and when the number of computers is adequate for users. Regarding the adequacy of computers, in case 1, one of the departments showed that quality of patient care was affected negatively because the number of computers was too few to be able to support patients in a timely manner; thus, here, the number of computers was barrier to the process

Table 63: Factors affecting the quality of patient care through the EMR (using multiple regression method) – (SPSS output)

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
EC1- Top management commitment	-.050	.076	-.068	-.657	.512
EC2- Senior managers are helpful	.264	.090	.324	2.943	.004
EC3-Adequate training	-.125	.062	-.171	-2.016	.045
EC4- Computers are adequate in the hospital	.135	.049	.213	2.756	.006
EC5- Users are involved in the developmental process of EMR	.137	.054	.201	2.542	.012
a. Dependent variable: IoT6- Improves quality of patient care					

8.5.3.2.3.1.2 Patients' confidentiality and privacy

Unlike the other areas where there were differences in perceived benefits, case 1 and case 2 were very close to each other in terms of scoring the confidentiality and privacy of patients' information. Indeed, all cases scored these benefits on average more than 3.5 with negative skewness. This means that all the cases generally accepted that the EMR enhanced patient privacy and confidentiality. However, case 3 was significantly different (p-value<5% using ANOVA test in Figure90). This difference is presented in a visual form in in Figure 91. Indeed, it is not clear which factors affected perceptions of this kind of benefit for case 3. However, the main feature that dominated case 3 compared to the other cases was top management support.

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
IoT9- Enhances confidentiality of patient information	8.848	2	4.424	4.712	.010
	211.270	225	.939		
	220.118	227			
IoT10- Increases patient privacy	9.374	2	4.687	4.884	.008
	215.937	225	.960		
	225.311	227			

Figure90 : ANOVA analysis for patients' confidentiality and privacy

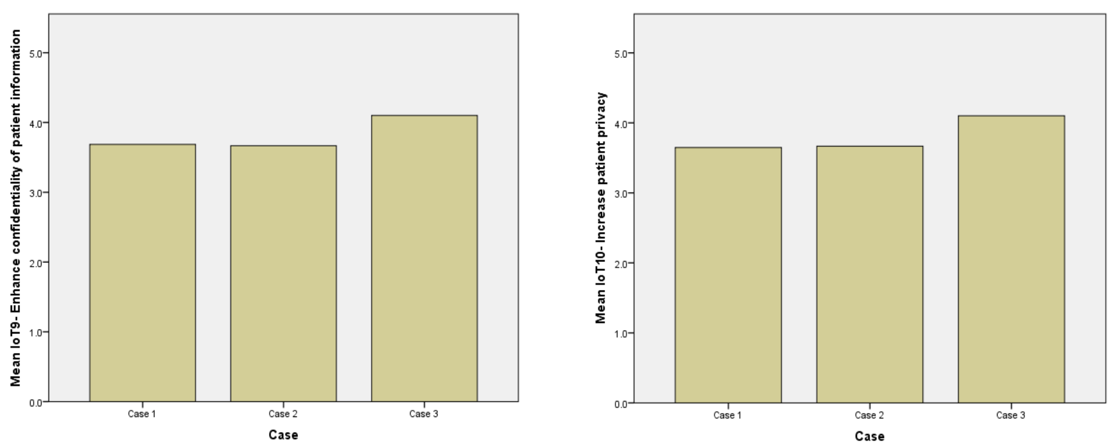


Figure 91: Enhancing the confidentiality and privacy of patients' care

8.5.3.2.3.2 Organisational benefits

Many organisational benefits were perceived to accrue from EMR implementation in all the cases. However, three benefits were found to be significantly different between the cases. These different perceptions related to staff communication, work efficiency, productivity and quality.

8.5.3.2.3.2.1 Staff Communication

Due to the unique nature of case 3, as it was dominated by international users and staff from diverse backgrounds, it was pointed out that EMR enabled this diversity to be unified and integrated:

> *"The EMR solved the problem of discrepancies among doctors. As you know, we have doctors from different nationalities and with different backgrounds, education and experience and all these differences were reflected in the treatment plans, diagnoses, progress notes and use of abbreviations. This affected effective communication among doctors. These problems don't exist anymore with the implementation of the EMR."* KFGD001- P33

The comment above illustrates why EMR enhanced communication more significantly than in other cases which were dominated by Saudi staff and users; this can be clearly seen in Figure 92, This is also why there was no significant difference between cases 1 and 2 in the means for "improved staff communication".

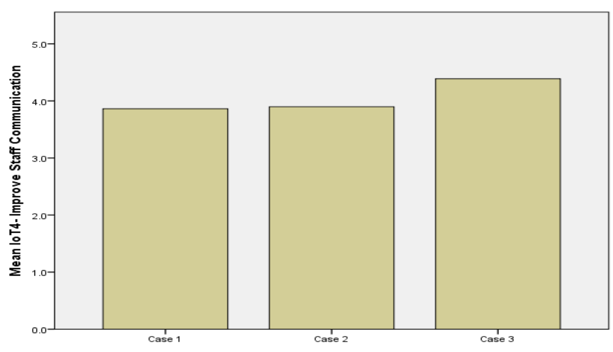


Figure 92: EMR improves staff communication

8.5.3.2.3.2.2 Productivity and quality

The differences in terms of productivity and quality were much bigger than for other benefits shown in the qualitative data. The major difference between staff perceptions in case 1 and case 3 was that one (case 1) believed that EMR decreased performance while the other (case 3) believed it streamlined the processes. A Director in case 1 in the medical focus group stated his point of view and others in the focus group also accepted this point:

> *"It is slowing our work flow."* DFG001-P7

On the other hand, case 2 perceived something different, as a Nursing Director stated:

> *"It improves the flow of patients and information through improving productivity, decreasing delays and eliminating waste."* IQ006
>
> *"The system helped us save time, effort and labour."* IQ002

Case 3 perceived it had benefitted more than cases 1 and 2, as a Director noted:

> *"There is tangible improvement in the quality, efficiency, effectiveness of care and patients' safety. The productivity of the staff and the flow of patient and information, all have increased."* IK006
>
> *"The implementation of electronic medical records improves the quality of patient care and increases hospital performance and productivity."* IK002
>
> *"The implementation of electronic prescriptions has many positive impacts on the quality, efficiency and effectiveness of the work director."* IK004

The quantitative data supported the qualitative findings, which are also significantly different (P<5%), as illustrated graphically in the ANOVA analysis in Figure 93. Furthermore, as graphically presented in Figure 94, case 3 is scored the highest and case 1 the lowest in terms of perceptions that EMR increased productivity and quality.

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
SC7- Increased Productivity	20.781	2	10.390	8.725	.000
	267.939	225	1.191		
	288.719	227			
SC8- d Quality	14.797	2	7.399	6.836	.001
	242.445	224	1.082		
	257.242	226			

Figure93 : ANOVA analysis for increased productivity and increased quality

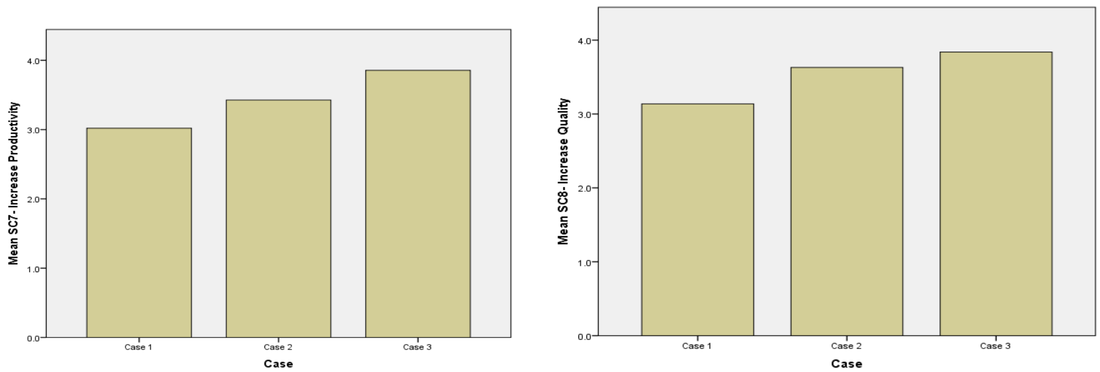


Figure 94: Enhancing efficiency, productivity and quality due to implementation of EMR

Chapter Nine: Discussion

This chapter discusses the implications of this research in relation to the literature and its aim to incorporate the research findings into the current body of knowledge. The results of this research are contrasted and compared with the previous work of other researchers. The chapter's structure follows that of the previous chapter in which each output is discussed alone. Finally, the whole framework is discussed in relation to the literature.

9.1 Introduction

EMR has been studied intensively in the advanced countries of Europe and America; however, less research has come from developing countries and fewer than a dozen studies have concerned Saudi Arabia. This country is different from other developing countries because its income is higher than that of many other such countries and the government is extremely willing to implement an Electronic Health Record System (EHR) to integrate all the hospitals of the Saudi Kingdom. As the Ministry of Health tweeted in 2015:

Figure 95: The Minister of Finance's tweet regarding the EHR implementation

The translation of the tweet in Figure 95 is as follows:

> "*One of our main missions is to have a centralised shared health record for each Saudi citizen which can be used anywhere in the Kingdom at any time. Implementing it needs some time.*" Ministry of Healthcare Twitter

Therefore, the first phase of this research started by exploring the level of EMR in the Eastern Province to indicate the level of EMR implementation. In 2011, Bah (2011) found there were only 3 hospitals which had implemented EMR in the Eastern Province and, in 2013, the present research found that nothing had changed in terms of the number of hospitals implementing it. However, this phase of research made some important new findings. First, the hospitals that had not yet implemented EMR had a very positive attitude to it but there was a strong belief among them that the current work process layout would not fit the EMR best-practice processes. Second, the level of EMR implementation had changed in three specific cases. In this study, the researcher found that the largest hospital (about 400 beds) in the Eastern Province was at level 1 after being at level 4, while a small hospital (with fewer than 100 beds) in a rural area had reached roughly level 3.

Therefore, the research question was narrowed down to asking why the small hospital mentioned above had done better than a big hospital in an urban area. The three cases (the large, the small and the average) were studied in-depth in order to understand this phenomenon.

After conducting a mixed-method case study research followed by a comparative study, the main reason found for the differentiated EMR implementation was the role played by top management in training, involving and enforcing employees to implement the system. This behaviour is explained by Badewi et al. (2013) in an ERP context by a virtuous cycle and death spiral. When the top management is committed, users have positive attitude toward the system because they receive a sufficient level of training and commitment from top management. All of this leads to a positive organisational attitude toward the system which, in turn, leads to further implementation of the system. This phenomenon has been described as a “virtuous cycle” (Badewi et al., 2013) and also as a “death spiral” in ERP implementation (Badewi et al., 2013). When the top management was not committed to the implementation, as was the case in case1, few resources were devoted to training, the level of involvement was low and the feeling of ease of use was also low. These factors appeared to lead to frustration and disappointment for users. Besides the technical problems and inability to manage them, top management decided to stop working with many components of the system and therefore downgraded from level 4 to level 1.

In the following sections, the first phase study is summarised and discussed to reflect its contribution to the body of knowledge, and to show how it affected the second phase of the research. Next, the motivational and de-motivational factors, which were both common and different across sites and which have already been presented in the previous chapter, are outlined and contrasted with the existing literature. Furthermore, it has been found that these findings could be explained using Herzberg's motivational theory to assess the necessities of each of these factors to "satisfy" and to "motivate" the hospital to use and to implement respectively the system further.

9.2 EMR in the Eastern Province

This research started with an exploratory questionnaire being distributed to 29 hospitals in the Eastern Province to ascertain how many of them had implemented an EMR system. Of the 23 hospitals that responded, only three had implemented EMR. This result concurs with the previous work of Bah et al. (2011), implying that little has changed over the past three years. However, the attitude of the respondents in the studied hospitals was generally positive in terms of their perception of its ease of use and the usefulness of the system even though their hospital had not yet implemented it.

The result of this research supports those of a recent case study conducted by Alharthy et al. (2014), also in the Eastern Province, in which physicians had a positive perception of EMR in terms of the ease of use of the system. However, the researchers found that the users were dissatisfied because the EMR system was too slow to be useful (Alharthi et al., 2014; Aldosari, 2014). Since the pilot study was conducted in hospitals that had not yet implemented EMR, this study could draw no conclusions regarding the satisfaction of the participants at these hospitals. Nevertheless, its participants did expect EMR to enhance and improve their organisations. The results revealed that there is an expectation that the significant number of hospitals that have not so far implemented EMR will support the implementation of the system.

In the present research, there was some concern amongst hospital employees that their organisational processes might be incompatible with EMR. However, this is not the main reason for hospitals not implementing EMR. The main reason for non-implementation of EMR seemed to be related to actions by the government which in 2008 decided to implement EMR in 30 hospitals in the Kingdom of Saudi Arabia,but in only three in the Eastern Province (Bah et al., 2011). The remaining hospitals were not provided with funding for this initiative. Nevertheless, the results of this research revealed that half of these hospitals developed their IT systems internally and 36% outsourced their system. However, these are customised systems with specific aims rather than EMR systems as defined earlier in the literature review.

Overall, although it is apparent that hospitals were clearly ready to implement EMR, they are mainly reliant on government financial support, which was not available. In addition, according to the results of this study and others in the literature, the speed and reliability of the system could be an issue once it has been adopted.

9.3 Motivational and De-motivational Framework

Within the analytic framework used in this research, which is described at the end of the literature review chapter, four underpinning theories could be used to help explain reasons for proceeding with EMR implementation (e.g. moving from level 1 to level 2 in the HIMSS analytical framework). The first underpinning theory is the Information System Business Success theory (DeLone and McLean, 1992; Delone and McLean, 2002; Petter et al., 2008; Bossen et al., 2013), which focuses on the perception of benefits and ease of use. The second set of theories, Technology Acceptance theories, complement this view by taking into account the attitude to the system (Venkatesh and Davis, 2000a; Venkatesh and Bala, 2008; Venkatesh et al., 2012). Without proper implementation, the perception of benefits and attitude to the system are both affected negatively. Therefore, the final underpinning theories are the EMR Critical Success Factor theories (MacKinnon and Wasserman, 2009), which focus on training and top management commitment.

Table 64 summarises the motivational and de-motivational factors. Only the “site-varied” factors (i.e. those that were different from case to case) are believed to be drivers for proceeding with EMR implementation. It is not claimed in this research that common motivational and de-motivational factors have no impact.

Table 64: Motivational and de-motivational factors: common and site-varied factors

<table>
<tr><th></th><th>Common</th><th>Site-varied*</th></tr>
<tr><td>Motivational</td><td>Perception of benefits
Escaping from the manual system</td><td rowspan="2">Information system capabilities
Top management commitment
Training and perception of ease of use
Attitude to the system</td></tr>
<tr><td>De-motivational</td><td>Service Level Agreement (SLA)
Technical problems
Funding problems</td></tr>
</table>

*these are the factors that affect the level of EMR implementation

9.3.1 Common Factors

The common factors were environmental ones, and these affected all the cases under scrutiny. While some of these factors were motivational, others were not. The only shared motivational factor for implementing the EMR appeared to be its perceived benefits. Nevertheless, not all cases perceived the same kinds of benefit. There was a set of de-motivational factors that were shared across all cases to reflect that these factors were beyond the control of the decision makers and users in these cases. These de-motivational factors were technical problems, coupled with an inability to deal with them due to lack of IT competences and an inappropriate Service Level Agreement with the EMR vendor. Furthermore, the funding limit in every case was predetermined by government, regardless of the actual funding required.

9.3.1.1 Common motivational factors

After analysing and comparing the cases, it became clear that the perception of benefits were motivational factors common to all the cases. Clearly, the main aim of any IT initiative is to realise the benefits from it and, according to the literature, investing in EMR is worthwhile (European Commission, 2011). The findings of this research support others in this regard. Physicians and nurses stated that they felt that the EMR improved the quality of the care they delivered, in particular by helping them to track their patients (as also found by Boas et al., 2014) since this affects patient safety (similar results were found by Anderson, 2007; Jayaram et al., 2011), effectiveness, patient centeredness, timeliness and efficiency (European Commission, 2011).

This present research found that not all of these benefits were realised in all cases to the same level since the overall effect was based on different "site-varied" factors. From another perspective, EMR benefits can be divided into clinical benefits (improved quality, reduced medical errors), organisational benefits (e.g., financial and operational benefits), and societal outcomes (e.g., improved ability to conduct research, improved health in the population, reduced costs) (Menachemi and Collum, 2011). Nevertheless, this research provides a new framework for the relationship between categories of benefits. First, it classified the research into data related benefits (e.g., benefits such as timeliness and accuracy of data); process benefits (e.g., streamlining and producing more efficient processes with fewer errors); decision- making benefits (e.g., medical decision making benefits and more efficient decision-making); and patient benefits (e.g., privacy and patient safety). These benefits are perceived to affect each other. As illustrated in Chapter Seven which examined the third case study, the availability of valid and reliable data across departments in live time enabled medical processes to be carried out faster and more efficiently with a lower number of errors. Furthermore, these data also enabled physicians, nurses, and pharmacists to make more knowledge-based decisions. All of these factors led to higher customer satisfaction with higher levels of privacy, responsiveness and safety.

This framework was developed based on the benefits map approach referenced in different handbooks and researches (Bradley, 2006; Bradley, 2010; APM, 2009; Ward and Daniel, 2006; Melton et al., 2008). However, it is believed to be the first, based on the researcher's knowledge, to understand how hospitals can increase customer satisfaction through EMR systems. Nevertheless, this research did not ask the customers directly whether or not they were more satisfied with this new EMR system. Therefore, it is recommended that a study should examine the proposed EMR benefits framework from the perspectives of patients, nurses, pharmacists and doctors. Furthermore, the proposed study attempted to explore in depth the factors that enabled each group of benefits to be achieved. According to OGC (2011) and OGC (2009), benefits are realised only when an intended blueprint is realised. So it might be asked what a hospital's blueprint should be in order to realise all groups of benefits.

9.3.1.2 Common de-motivational factors

The literature also refers to various de-motivational factors that can hinder EMR implementation. Jha et al., (2009) named these as funding requirements, unclear ROI, maintenance costs, physician resistance and inadequate IT staff.

The suspicion that the system was unreliable derived from the great number of technical (software and hardware) problems experienced in all three cases. The ability to repair technical breakdowns within an acceptable timeframe was not a trivial matter, but it was also aggravated by the lack of technical help in-house and of a proper Service Level Agreement. Although all the hospitals in this study faced these problems, the level of EMR implementation that they had achieved varied, meaning that the results of this study did not provide sufficient evidence to support the arguments in the literature that ease of use was the key motivator (Altuwaijri, 2010; Scholl et al., 2011). This does not mean that the factor had no impact on the current level of EMR implementation, but it cannot be used as evidence to explain the variation in the level of EMR implementation. Nevertheless, the impact of it was serious and could affect the business continuity significantly, as illustrated in all of the cases.

9.3.2.1.2.1 Technical problems

Unlike the literature that focuses on human beings as the main reason for a system failure, this research found that the main shared de-motivating factor in all cases was the incidence of technical problems and the lack of ability to deal with them. Similar to the ability to succeed through technical features and reliability (Scholl et al., 2011), most participants in the three cases claimed that technical problems had been the main restraining factor. The literature too suggests that technical problems are usually one of the hindrances to successful EMR implementation (Ajami and Arab-Chadegani, 2013).

As the three cases revealed, technical problems led to employee frustration. This was because of the slowness, crashing and freezing of the system, which was the result of using old or inadequate computers, inferior network connectivity or a disintegrated system which obliged users to do the same work twice over. Poor and/or slow computers, or too few of them, cause bottlenecks in organisational processes, leaving users feeling that there is a mismatch between the organisational processes and EMR processes. This feeling of misfit can lead to frustration and ultimately to a failure of the system, as discussed in the Enterprise Resource Planning literature (Wang et al., 2006). Furthermore, as demonstrated in case 2, the inability to customise the system to their needs affected users negatively. According to Struik et al. (2014), a perceived inability to customise a system to fit users' needs is known to be a de-motivating factor for users and key decision makers.

9.3.2.1.2.2 Service Level Agreement

A Service Level Agreement is a binding contract between the user and the vendor of an IT service (Adams, 2009). It details the acceptable average time between two incidents and the time allowance for fixing incidents (Addy, 2007; Adams, 2009). Without an effective Service Level Agreement, the perceived service level can be affected negatively (Liu and Ma, 2005). The interviewees in the three cases reached a general consensus that their vendor was not helpful and cooperative. When an incident occurred, the vendor was too slow in responding. Apart from the frequent technical problems, the vendor was not cooperative and there was no agreement to organise the quality of the service delivered.

Supported by Liu & Ma (2005) in their study of the effect of the perceived service level on the perceptions of usefulness, ease of use and use behaviour in medical applications, the perception of the service level did not necessarily affect the perception of usefulness (the third case, for example, faced technical problems but the users and decision-makers still conceded its usefulness). However, a low level of service can affect the ease of use and use behaviour. For instance, in case 1, users felt that the system was hard to use due to its instability. If ease of use is defined in terms of the work needed to perform the task (Bossen et al., 2013), then instability means the work many have to be done many times (Liu and Ma, 2005). As supported by the literature (Moores, 2012), it must be concluded that the numerous complaints and inability to manage the business continuity risk in the first case pushed the decision makers to degrade the system.

9.3.2.1.2.3 Funding Limits

A number of researchers have claimed that funding problems are the main obstacle to EMR implementation in developing countries (Scholl et al., 2011; AL-ASWAD et al., 2013; Turan and Palvia, 2014; Avgerou, 2008). Nevertheless, while, in the present research, funding limitations were a common factor affecting all cases, it was not a driving factor since the case with the highest funding amongst all studied cases had the lowest level of implementation (case 1), but the case with the relatively lowest funding among all cases had the highest level of implementation (case 3).

The problem to address is in fact the ineffective allocation of resources rather than a limited budget (Jha et al., 2009), what is sometimes called “managing the IT investment portfolio” effectively (Peppard and Ward, 2004; Daniel et al., 2014). This study, in reflecting this view, showed that case 1 invested a great deal more than the other cases in EMR components (hard assets) but invested very little in training (soft assets). Regardless of the amount of funds available, the first case is now doing better than the others although it is still below what the user would term acceptable, in terms of the ability to deal with technical problems, access to funds and its relationship with the vendor. However, this case had the lowest level of EMR implementation. Conversely, case 3 invested a great deal in its soft assets while case 2 invested in both soft assets and hard assets. Being unable to afford a comprehensive EMR system, it used its internal finance to develop a cheaper alternative to its internal resources (IT staff and users).

9.3.2 Site-varied factors

The size of hospitals causes unique challenges to manual systems, which are costly to maintain, require space for the bulky paperwork and are unreliable, in that records can get lost (Thakkar and Davis, 2006). One of the main reasons for adopting EMR is to end these problems. Therefore, previous researchers have argued that EMR adoption depends upon the size of a hospital and its financial capabilities (Jha et al., 2009). Consequently, a significant part of the literature review suggests that the success of EMR is positively related to the size of the hospital (Paré et al., 2014; Ahmadi et al., 2015).

However, another stream of research believes that smaller hospitals do better in this regard than bigger ones (Kazley and Ozcan, 2009). This research found evidence from the first case under scrutiny, which was bigger in size and financial capability, to indicate that financial constraints are not necessarily the critical cause of failure in an EMR implementation. Without doubt they have an impact; nevertheless, this impact is not the sole critical or even determinant factor; others seem to be more significant and potent than financial matters.

This study contributes to the knowledge base by identifying the factors that were perceived to be different across cases; they could thus be referred to as motivating factors for further levels of EMR implementation. Top management commitment and involvement, adequate training, user involvement, perception of ease of learning/use, positive attitudes, and the perception of certain types of benefit (the quality of patient care, patient confidentiality, staff communication, efficiency and productivity) were all perceived to be different from case to case.

9.3.2.1 Capabilities of the information system

The uniqueness of the third case was apparent: it had the lowest level of resources allocated to it and the least commitment from the government. Nevertheless, it had achieved the highest level of EMR implementation in the Eastern Province according to the first phase of this research. This contradicts much of the literature in this field. In addition, this hospital faced a huge number of obstacles, such as being in a rural area, being far from the EMR vendors and lacking what might be described as high profile human resources (due to being in a remote area). None of these obstacles was raised by the decision makers in conversation. However, when the reason for this is understood, the situation makes more sense. The main reason for achieving this abnormally high level of performance was the capabilities of the information systems of this hospital. This is a unique characteristic, and believed to be the distinguishing factor. According to Melville et al. (2004), IT can help to create competitive advantage and add value to the organisation but only if it is complemented by IT organisational assets. This case reflects such a view.

Furthermore, the reward and punishment system used to enforce implementation was perceived to have a strong impact on successful implementation. Of the three cases, case 3 had integrated its compensation system and consequently performed better than the other cases. This result supports the claims in the literature. For instance, Miller & Sim (2004) found that attaching a reward and compensation system to the quality of use was critical for a successful EMR implementation.

Likewise, Liang et al. (2013) revealed that reward (the carrot) and punishment (the stick) had an effective impact on the successful implementation of radical projects such as ERP systems. Therefore, in this research, it is proposed that, based on the empirical evidence and the literature, using both the carrot and the stick in managing EMR implementation can form Information Systems Capabilities that enable a hospital to perform better than average in its use of the EMR.

9.3.2.2 Top management commitment

The commitment and involvement of top management are perceived to be key drivers of other motivational factors and of proceeding with EMR adoption. As the previous literature shows, top management commitment ensures the allocation of sufficient resources at every step of the implementation process and even supports redesign if needed (Jha et al., 2009; Townes Jr et al., 2000; Gans et al., 2005). As discussed above, channelling the resources effectively leads to a successful implementation of EMR and therefore further motivation to attain an even higher level of EMR. Financial support from management can take the form of training in computer adequacy while linking compensation systems with meaningful use, training and the perception of computer adequacy are perceived to be the most prominent factors that affect other psychological and social factors.

Human problems in relation to the implementation of EMR start with top management lacking commitment to the new system. This is one of the critical failure factors highlighted by information system research (Struik et al., 2014). A lack of commitment from management and inadequate user training can limit the involvement of employees in the implementation phase. Consequently, involvement in the post-implementation phase and perceived ease of use can be significantly affected. As stated in the EMR literature, lack of involvement affects perceptions of ease of use (Altuwaijri, 2008); additionally, perceived ease of use affects the use of the technology (Gagnon et al., 2014; Kowitlawakul et al., 2015). By feeling a negative attitude towards ease of use and usefulness, employees will not be able to realise the benefits of EMR.

9.3.2.3 The cases' attitudes to the EMR

The literature identifies those factors that affect attitudes to information systems in general (Petter et al., 2008; Delone & McLean, 2003) and EMR systems in particular (Seeman and Gibson, 2009). Ease of use, meaningful use, efficient training and a successful implementation of the system are found to affect the attitude to EMR (Hsieh, 2015).Indeed, according to the Theory of Reasoned Action (Montano and Kasprzyk, 2008), attitude is one of the key determining factors affecting intention to use and a user's behaviour.

This research is different from others in that it reveals that the main output for top management commitment and the sufficient training of users is a positive attitude. A positive attitude and the perception of benefits are perceived to be part of a continuous loop (i.e. the higher the attitude, the higher the meaningful use (Narcisse et al., 2013) and therefore the higher the perception of benefits). Such an attitude is perceived to be not the same as that in the first case, which scored the lowest for attitude, in contrast to case 3, whose score was highest. The question of attitude was reflected in case 2 where financial limitations had to be overcome in order to develop an internal PACS. Although this PACS had many technical problems, as it was developed and implemented by non-professional IT staff, the attitude to it was accepting and positive, much more so than the attitude in case 1 where a professional PACS package had been purchased.

9.3.2.3 Training and perception of ease of use and usefulness

Training is perceived to be a key driver in raising the EMR implementation level. Without sufficient training, users will lack the IT skills required for successful EMR implementation (Scholl et al., 2011); thus, they will be de-motivated to use the system (Burton-Jones and Grange, 2012). As illustrated in the previous chapter, a case that focused more on training had a higher EMR implementation level. As the analysis in the previous chapter showed, different levels of training across cases led to different levels of perception of ease of use.

Furthermore, since the training delivered for the second case in the present study was higher than for the first, the case 2 participants had a generally more positive attitude to EMR implementation, unlike their case 1 counterparts and the views recorded in the Saudi EMR literature (Alharthi et al., 2014). One of the case 2 decision makers even suggested that EMR systems should be standard in all hospitals in Saudi Arabia. Just as with the Technology Acceptance Model (TAM) (Mathieson, 1991; Hsieh, 2015), there is evidence in this case that a positive attitude to the system translated into meaningful use. However, apart from the positive attitude, the motivational factors that case 2 shared with case 1 were a perception of the current benefits of the EMR and the chance to escape from the manual system. This supports the previous literature, which claims that effective training is required for perceived ease of use and for effective use (Burton-Jones and Grange, 2012), sometimes called 'meaningful use' (Narcisse et al., 2013).

What is more, the present research also supports the previous work of Venkatesh and others in relation to the Technology Acceptance Model (TAM) (Venkatesh and Davis, 2000b; Gagnon et al., 2014; Hsieh, 2015) since the greater the perceived ease of use and meaningful use, the more widespread the perception of benefits. Indeed, perceiving to achieve these benefits further increased the commitment and involvement of both top management and other users and therefore promoted EMR implementation (Badewi et al., 2013). All the factors affected each other in a closed loop: the commitment of top management led to training and this led to a more widely perceived ease of use and of usefulness which, in turn, benefitted the realisation process, and this impacted on the commitment of top management. A closed loop system of this kind was previously outlined in another IS discipline, namely, that of Enterprise Resource Planning (ERP) systems

Chapter 10: Conclusions

10.1 Introduction

Without doubt, EMR has various benefits and therefore many hospitals have invested substantial amounts of money in it (Greenhalgh et al., 2010). Despite these benefits, studies in the literature have highlighted some drawbacks associated with EMRs, which include the high upfront acquisition costs, ongoing maintenance costs, and disruptions to workflows that contribute to temporary losses in productivity because a new system must be learned (Menachemi and Collum, 2011). Moreover, EMRs are associated with possible concerns from patients over privacy which have been further addressed legislatively in the HITECH Act. Overall, experts and policymakers believe that significant benefits to patients and society can be realised when EHRs are widely adopted and used in what is called a "meaningful" way. This chapter starts by summarising the main research findings and then sets out the research implications. Finally, before a section suggesting a direction for future research, the research methodology is evaluated to show the strengths and weaknesses in a section on the research limitations.

10.2 Main findings

The main outcome or finding of this research is the motivational and de-motivational framework. It is new and is different from other frameworks that have been developed to understand the process involved in motivating hospitals to further implement the EMR. In the Saudi Arabian context, it has been found that common factors, such as lack of investment and the quality of Service Level Agreements, are not drivers accounting for variations in further implementation of EMR (as presented in the discussion section). However, it cannot be claimed that these factors are irrelevant or not critical in restricting the ability of a hospital to go further. This research takes the motivational perspective as a lens for understanding why different hospitals in Saudi Arabia, under the same contextual factors, are behaving and are motivated differently toward EMR implementation and its further implementation.

One very clear outcome of this research is that the size of the hospital, whether big or small, is not the main reason for the level of benefits achieved. It is clear that this depends on the commitment of top management throughout all three phases of the EMR implementation. This is the starting point for the successful implementation of EMR (Badewi et al., 2013). The commitment of top management is one of the most significant components of an information system's capabilities (Melville et al., 2004). Other determinants of these capabilities are training and user involvement. In fact, the level of training and user involvement both seem to be associated with the perceived ease of use and the usefulness of the innovation, which increase the benefits associated with using EMR. These positive perceptions work as a 'virtuous cycle'(Sterman, 2000) in terms of top management feeding back into the commitment which, in turn, leads to more resources being devoted to making EMR a success and to yet higher levels of the EMR being implemented.

In contrast, the 'death spiral' phenomenon (Sterman, 2000) was observed in the first case. The management was not committed to EMR implementation and this lack of commitment led to a low level of training, which led to negative perceptions regarding its ease of use and usefulness. This negative attitude culminated in many complaints being made about the system and, as a consequence, the hospital decided to stop using many EMR features, regressing from approximately level 4 to level 1.

10.3 Research Implications and Recommendations for Professionals

These research findings have many implications that can help professionals and decision-makers in the health sector to increase the probability of EMR success and to enhance organisational attitudes, encouraging the implementation of higher levels of EMR than exist at present in their organisations. Below is a list of implications.

1. Since top management's commitment is perceived to be the main driver of success, a governance board of decision makers (such as a sponsoring group or Senior Responsible owner) should be set up to:

a. Bear the responsibility and accountability for implementing the system. Otherwise, without a real buy-in to the EMR system from top management, the investment in it is a waste of time and money.

b. Formulate and write a proper SLA that maintains the quality of the system in order to overcome the users' frustration due to a perceived low level of system reliability.

c. Manage the perceptions and attitudes of users regarding the EMR system.

d. Hold regular meetings with EMR users to learn the challenges that they face.

e. Set and enforce (using a carrot and stick approach) newly required EMR medical processes, policies and rules, as it has been found that the ability to enforce these new policies was one of the key success factors for the third case studied in this research.

2. In all cases, IT is responsible for the successful implementation of EMR. Nevertheless, top management may or may not be interested in it. The concept of EMR as an IT project could even mislead decision makers and users. IT is one element out of the five (together with People, Organisations, Technology and Information) of the future expected blueprint (OGC, 2011).

3. Attitude is perceived to be critical for EMR success. Therefore, it is advised to have change readiness indicators to use in managing stakeholders' perceptions.

4. Since attitude is associated with training and perceived ease of use, a periodic questionnaire should be issued to evaluate the current training needs, perceptions regarding use, and attitude levels in order to decide the kind and level of investment required for system training.

5. In order to ensure the stability of the level of EMR use and its "meaningfulness", in recruiting new physicians and nurses, the chosen candidates should be certified for using such information systems (e.g. Certified Professional Health Care Information and Management System (CPHIMS)). Older, experienced physicians or nurses

should be treated differently; they may require extensive training or need an assistant to do the work of the EMR.

6. As noted from cases one and two (illustrating two extremes of users' involvement before the implementation of EMR), it is recommended that before implementation, users should be involved and their views should be taken into consideration.

7. In case three, the enthusiasm of users was one of the critical factors for success. Thus, in the implementation stage, support from enthusiastic users should be used to lead the change against those who want to resist it.

10.4 Research Limitations

This research was a multi-phased study which began by using quantitative research to identify the level of EMR implementation in the Eastern Province of the Kingdom of Saudi Arabia. Afterwards, case study research was used to study in depth three cases of hospitals which had implemented the EMR system. This phase of the research used mixed methods to understand the variation in EMR performance in the three cases and to understand why these cases had attained different levels of EMR. The research findings were validated by the literature through a process of comparison and contrast.

10.4.1 Triangulation of the Research Methods

On the one hand, questionnaires help to elicit knowledge from a large number of people at once. However, they do not enable researchers to understand a phenomenon in depth. On the other hand, qualitative research, based on interviews and focus groups, enables a researcher to gain insights directly from those with hands-on experience. Therefore, mixing the two methods enabled this researcher to understand in detail the reasons for the variation of EMR implementation across the cases. Nevertheless, it cannot be argued that this research allows the results to be generalised across all hospitals in the Saudi Kingdom for the reasons shown below. Nonetheless, the triangulation enhanced the reliability of the findings by using three sources for verification (Lee and Hubona, 2009; Zachariadis et al., 2013).

Furthermore, triangulation benefitted the researcher as it enabled her to explore expected weak points (i.e. attitudes and perceptions) in every case across large number of respondents at one time. Qualitative methods enabled her also to explore other things that were not clarified in the literature, such as SLAs and the use of reward and punishment policies for aligning the behaviour of users to the success of the system. Furthermore, qualitative analysis enabled the researcher to validate previous theories that could not easily be validated through questionnaires such as the funding limits, the hospital size, and technical problems.

What is more, combining the results from the quantitative (i.e. questionnaire) and qualitative methods (e.g. interviews) enabled the researcher to formulate the motivational and de-motivational framework. Finally, the questionnaire was helpful in clarifying the differences between the cases in different areas such as attitudes, perceptions, training needs, and perceptions of computer adequacy. All of this contributed to build a robust framework based on strong evidence.

10.4.2 Generalisability versus applicability in the results

As stated in the research methodology chapter, the underpinning research ontology here is that there is no single reality. In other words, the circumstances and environmental factors in one area are not necessarily the same as in others. This was part of the rationale for using a case study approach. Therefore, this research does not claim that the results can be generalised across all hospitals in the country since its evidence was drawn from three cases only in a certain area of the Kingdom (the Eastern Province). Nevertheless, it argues that the results are “applicable” so long as the environmental factors in these cases are similar to those in the results-applicable-case (Kaplan and Duchon, 1988; Stake, 1995).

10.4.3 Challenges in conducting research methods

In the first phase of the study, the survey research, the challenge lay in the ability to formulate a reliable and valid questionnaire. Besides depending on the literature review for formulating questions, content validity was tested by using a focus group. The focus group in the first phase was used to modify and customise the questionnaire imported from the literature to ensure that the respondents would understand it (content validity). However, only one or two respondents ever attended the focus group meetings so after a couple of disappointing attempts, the researcher consulted four users individually to discover if they were able to understand the questions.

In the second phase of the research, the case studies presented different methodological challenges (see Table 65). However, apart from the researcher's inability to meet the CEO of case 1, all the challenges were met. Since the decision to stop using different components of EMR and downgrade from level four to level one had been taken by the Chief Executive Officer (CEO), interviewing him, as had been the aim, would have made a very important contribution to the present research; it would have been useful to know the main motivations and circumstances of this decision from his point of view. However, he came to none of the appointments he made.

Other challenges, such as the fear of being recorded and respondents' tendency to promise an interview and fail to keep it, were dealt with effectively and efficiently by using different mitigation strategies, such as frequent reminders of the privacy of the data and the repeated promise that the data would never be used against them or be sent to their boss. Likewise, in the focus group, bringing all the members together at the same time was a major challenge. However, after they had missed many appointments, the director was spoken to and he persuaded the decision makers to attend.

What is more, as regards documents, I was interested in studying the SLA terms for every case. However, none of the decision makers in the three cases knew anything about any contract between them and the vendor. They did not even know who had written these contracts and what means had been used. The contracts were renewed without any consent or knowledge on their part.

Regarding the questionnaire, it was not possible to circulate the questionnaire in English as the expected respondents spoke Arabic and it would not have been easy for them to understand questions in English. Therefore, the questionnaire was translated into Arabic, as discussed in the research methodology chapter.

Table 65: Methodological challenges faced by the researcher

	Challenges	Dealing with it
Interviews	Inability to meet the CEO even after making many appointments with him.	After many missed appointments with the CEO, I asked other decision makers the questions I had in mind.
	There was a fear that recordings of the interviews could be used to incriminate respondents in the eyes of their managers. There was a suspicion that this research could be used to put respondents in a difficult position.	I reminded them from time to time that these data were being collected for academic purposes only and the information was confidential.
	Some interviewees failed to attend their promised interviews	I reminded them, contacted them regularly, and promised them confidentiality for the data collected.
	Inability of many to speak English.	The interviews were conducted in Arabic, the native language of the researcher and the respondents.
Focus Group	In case 1, many focus group meetings were arranged but few attended them.	I talked to the medical director and the nursing director. Both directors persuaded others to attend the focus group.
Documents	The absence of contracts with the EMR vendors, including the SLA.	I asked about them many times, but nobody knew anything about these contracts. After many attempts to find out from different decision makers, I found, in three cases, that they were kept secret by the finance department or by the government and the IT staff knew nothing about them. Therefore, I used the interviews to learn more about the nature and type of relationship in each case with the vendor.
Questionnaire	Inability to read the questionnaire in English	Translating the questionnaire into Arabic.

10.5 Future Research

This research may help practitioners to understand the factors that might limit the ability of hospitals to implement EMR. Therefore, it is suggested that future research operationalises these factors into a questionnaire that can be used as an assessment model for evaluating the ability of hospitals to implement, use and adapt the output of EMR systems. Furthermore, all three cases studies were conducted in the same area, the Eastern Provence, and with the same EMR vendors.

Furthermore, research that compares government and private hospitals is recommended. Some public hospitals (not under the Ministry of Health), such as the hospitals of the National Guard, have achieved EMR implementations at level six (Altuwaijri, 2008); it is not known why these hospitals are so much more advanced than government hospitals. The previously identified factors, such as funding limitations and government support, common to the three case studies, which are all government hospitals, may explain this difference in performance since these factors are not common to private hospitals.

Recommendations for future research can be classified into three streams: the theories that can be used to enhance understanding of motivations to implement EMR further, the impact of common motivational factors on EMR implementations, and generalising the results of site-varied factors.

10.5.1 How can the motivational and de-motivational framework be enhanced?

Based on findings from the comparative study conducted in Chapter 8 and the previous discussion in Chapter 9, it seems clear that Herzberg's motivational theory could help. This theory could help in understanding which factors are necessary to satisfy users (without the existence of these factors, the top management might decide to stop using some or all parts of the system), and which are necessary for pushing the top management to decide to further implement the system. Herzberg differentiates between hygiene and motivator factors (Herzberg, 1968). While hygiene factors are required to satisfy employees with conditions at work, motivator factors are required before employees are prepared to do extra (Herzberg, 1974; Herzberg, 1968). Likewise, certain factors are required to make users of EMR satisfied but they will not necessarily motivate them to implement EMR further. In addition, certain factors are perceived as necessary to persuade employees to do more than their peers; such hygiene factors are proposed to be factors that affect perceived system reliability. In other words, technical problems with the system have been found to increase the resistance of users against the system (Gagnon et al., 2014).

Furthermore, supported by the literature (Bharadwaj et al., 2009), these technical problems affect business continuity which pushes top management to stop using the system. However, these are perceived to be general hygiene factors, such as are required for ensuring satisfaction with EMR in all cases. However, they are not necessarily required for further strengthening the case for implementing EMR.

Table 66 proposes different factors that can be seen as hygiene factors while others are motivational factors only. Indeed, what can be claimed here is that the common factors which emerged from the three EMR cases in this research could be said to be hygiene factors. Nevertheless, there is strong evidence that the first case regressed to the first level because of the technical problems. Therefore, as discussed formerly, the perception of technical reliability is the foremost aspect to be considered as a hygiene factor. Likewise, the main aim of implementing EMR is to overcome manual work problems so unless these main benefits can be realised, there is no reason to put the hospital under the pressure of implementing the system. Nevertheless, other benefits, such as process and patient benefits, as discussed in the following section, are perceived to be motivators to implement the system further. Moreover, other factors, such as top management commitment, attitudes and adequate training, are necessary to motivate the hospital to implement the EMR further.

Table 66: Combining the motivational and de-motivational framework with Herzberg's motivational theory

	Hygiene factor	Motivational factor
Common factors	Perceived technical reliability (e.g. SLA, IT infrastructure)	
	Perceived benefits by overcoming manual problems	
Site-varied factors		Top management commitment
		The use of punishment and reward for implementing the system
		Positive attitudes toward the system (e.g. ease of use, usefulness, stimulating and interesting)
		Adequate training

10.5.1.1 EMR benefits as hygiene and motivating factors

Although the perception of benefits is widely perceived as a key factor in EMR diffusion in the literature, this research found that not all benefits could motivate its dissemination. A benefit that is perceived to be a hygienic common benefit (i.e. required but not sufficient) but which may not be critical (Herzberg, 1974) with regard to motivating hospitals to move forward, is the overcoming of the drawbacks of the manual system.

In other words, the main hygiene benefits are proposed as the problems that stem from manual work and these can be avoided by automating the process. Since such manual work is based on handwriting as a way of encoding the messages between parties, such as nurses and pharmacists or doctors and pharmacists (Carayon et al., 2014) (as supported by the literature), illegible handwriting hinders effective communication in terms of medical errors (Jayaram et al., 2011; Anderson, 2007). In addition, storing information in a manual format increases the size of the storage area to the point where it is very difficult for users to access this information later. Therefore, it was found in this research, and supported by the literature, that EMR improves archive management (Rothschild, 2004; Poissant et al., 2005) and improves the integrity and accuracy of data (Burns, 1998). EMR, as an automation tool, overcomes the problem of legibility and documentation storage, an advantage which was common to all cases (all the levels of EMR implementation covered in this research). Therefore, these benefits cannot be claimed to be motivators for further EMR implementation. Rather, they appear to be hygiene benefits: without them, EMR is meaningless to the user.

Nevertheless, motivator benefits are proposed in this study as they were found to be a reason for the different consequences of EMR implementation, such as benefits to patients (including quality of patient care and patient privacy) and organisational benefits (staff communication, effectiveness and productivity). Since the level of "meaningful use" affects the realisation of benefits (Narcisse et al., 2013; Blumenthal and Tavenner, 2010), as suggested by the comparative study, the users' ability to utilise the EMR was the main determinant for realising these distinct benefits. This realisation of benefits leads to a positive attitude to the system and helps to form a virtuous cycle that leads to higher EMR implementation (Badewi et al., 2013). It is worth noting that, as discussed in the previous chapter, the differences in realising different benefits are not a consequence of the level of EMR implementation because case 1 had achieved level four before regressing to level one.

Other potential motivating benefits were not found in the three cases under scrutiny (and are recommended for future studies to address). They are patient-centeredness (Dimick, 2011); decision making and research-enabled benefits which come from attaching a decision support system to the EMR (Kawamoto et al., 2005); or operational, accounting and management benefits that come from integrating business software (such as Enterprise Resource Planning (ERP)) in the EMR (Menachemi and Collum, 2011). Hence, it is recommended that a set of studies should investigate these benefit motivators.

10.5.2 The Impact of Technical Problems, Mitigation Strategies and Risk Tolerance

All hospitals in this research were working with the same EMR vendor. However, none of the research cases was able to achieve the other organisational and social benefits discussed earlier (Menachemi and Collum, 2011). The reason for this might be the presence of technical problems. Although this point is covered in the literature

(Altuwaijri, 2008; Altuwaijri, 2010; Scholl et al., 2011), no single study has been devoted to clarifying this. It is recommended that the association between the perception of EMR's reliability in terms of less frequent incidents and the ability to remedy them within acceptable time limits, and the EMR implementation level should be pursued in a reductionist study.

One of the common de-motivating factors was the Service Level Agreement. However, even though all the cases had the same vendor with the same less than adequate Service Level Agreement, it cannot be declared unequivocally that this contract was a reason which prevented these cases from going further. The evidence is exclusively based on what the users said. Nevertheless, it is recommended that these research findings require another comparative study to back up the findings, this time examining two hospitals working with the same vendor but with different Service Level Agreements.

It is not clear whether this affected the level of EMR implementation, perhaps because an SLA increased the perception of it being a reliable service (Turan and Palvia, 2014). Meanwhile, other factors, such as funding limitations, considered as common factors in this study conducted in a single area of Saudi Arabia, might not be relevant in other places. For instance, in the USA, more government funding is available for the implementation of EMR than in Saudi Arabia (Korin and Quattrone, 2007). However, the level of EMR implementation in the USA is still lower than in the UK, for example (Robertson, 2013).

Therefore, it is recommended that other studies use structured data collection methods, such as a questionnaire delivered to the whole population of 240 governmental hospitals, in order to generalise results. However, using a questionnaire alone could be misleading, since the respondent could either be a user or a decision maker, which might lead to same-response bias. Hence, different questionnaires for decision makers and for users should be sent to each hospital. Otherwise, an alternative means of generalising the results would be to conduct a series of case studies in other provinces of Saudi Arabia to replicate this study.

Furthermore, although it was believed that, in this research, technical problems affected all cases similarly, the impact of such problems is serious and can affect business continuity risk significantly, as illustrated in all of the cases. Therefore, the decision makers' risk tolerance with regard to business continuity might be a factor that affected the EMR implementation level. In other words, because case 1 was bigger and older than the other hospitals, and because the average ages of decision makers were larger, their risk tolerance would be lower than the smaller hospital that was dominated by younger staff and decision makers.

In summary, Table 67 provides an overview of the recommended research regarding the impact of technical problems, how a hospital might mitigate the technical risks, and the decision makers' tolerance toward such technical risks. Some research studies could be formulated based on testing propositions while others could conduct further exploration and/or investigation.

Table 67: Future research recommendations regarding the impact of technical problems, mitigation strategies, and risk tolerance on the EMR implementation level

Future research	Proposed methodology
EMR's perceived reliability in terms of less frequent incidents and the ability to remedy them within acceptable time limits on the EMR implementation level	Survey research to test this proposition by testing the relationship between the perceived reliability level and EMR implementation level.
Does the quality of the SLA affect the level of EMR implementation?	Comparative case study is required to compare the two cases: one with a good SLA and another with a bad one. This is to find out whether or not the quality of the SLA affects the EMR implementation.
How a proper Service Level Agreement (SLA) affects EMR implementation	Mixed research is required. Qualitative research to define the "proper SLA" in an EMR context and to examine how each property of SLA affects one or more attributes of EMR success. Quantitative survey research should examine the relationship between each group of SLA properties on EMR implementation success dimensions.
The impact of decisions makers' risk tolerance toward business continuity in IT systems on the level of EMR implementation	Survey research to test this proposition by testing the relationship between the level of risk tolerance of decision makers and the level of EMR implementation.

10.5.3 Top management commitment and the existence of senior responsible owners for EMR implementation

Since the attitude of top management is one of the key factors for success, it is recommended in the programme management discipline (OGC, 2011) in general, and in the benefits management discipline in particular (Badewi, 2015; Bradley, 2010; Melton et al., 2008) that the designation of a benefit owner and/or a senior responsible owner can affect the success rate of change initiatives (Zwikael and Smyrk, 2015). Likewise, in a recent study conducted on EMR in Saudi Arabia, Altuwaijri et al. (2011) found that when top management took on the role of Senior Responsible Owner (SRO), the success of an EMR implementation increased. Therefore, it is recommended that a committee of clinician staff should be formed to take the responsibility for EMR implementation, where the role of IT experts is simply to support the system technically. In addition, a relevant person (for example, a physician for the physician systems and a pharmacist for the pharmacy system, and so on) should be allotted work as a business change manager (BCM)(OGC, 2011) to manage the attitudes and change, to determine the To-Be list, and follow up the change process in order to realise benefits.

Nevertheless, it is not clearly known whether this strategy could enhance the ability of a hospital to move from a lower level to a higher one. Therefore, it is recommended that comparative case studies should be conducted between two cases, where one has such a committee while the other does not. It is believed that this would provide clear evidence as to whether or not the existence of this committee would be vital and, if it is vital, what characteristics of this committee would be useful?

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A1: Interview Document

A1.1: Participant information sheet for the interviews

Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals in Kingdom Saudi Arabia

1. Research Project Title

Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals (MoH) in Kingdom Saudi Arabia

2. Invitation paragraph

You are being invited to take part in an interview of a research project. Before you decide it is important for you to understand why the research is being conducted and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this information.

3. What is the project's purpose?

I am conducting this research as a partial requirement for my PhD degree at University of Sheffield, UK. The purpose of this interview is to explore the barriers, and facilitators of electronic health record implementation in hospitals of Saudi Arabia. Additionally, I am looking for possible solutions to overcome those barriers. This study will help the ministry of health (MOH), Saudi Arabia to design policies accordingly to make this transition process smoother.

4. Why have I been chosen?

On the basis of survey's result, hospitals were divided into blocks according to their current transition stage based on HIMSS model (e.g. stage zero to stage seven) - this is a tool which classifies the level of EHR implementation. Your hospital has been selected as there are several hospitals all in the same stage of HIMSS and I'm looking to compare the experiences you have all had to identify common themes and lessons for the future.

Being decision maker in your hospital, you are fulfilling our inclusion criteria to be considered for interview. It would be our pleasure if you could spare time for an interview.

5. Do I have to take part?

Participation in this research is entirely voluntary and it is up to you to decide whether or not to take part. Your refusal to participate will not involve any penalty or loss of benefits to which you are otherwise entitled. If you do decide to take part in research you need to sign a consent form (attached with this information sheet). Even after giving consent, you have the right, not to answer any question you do not want, any time during interview without giving a reason and this will not affect your rights or benefits you are entitled to. If you decide to participate in research you will be given a copy of the information sheet and a signed consent form for your personal record to keep.

6. What will happen to me if I take part?

If you decide to take part in this research, I will arrange an interview with you. It will take approximately 30-45 minutes. Interviews may be conducted on telephone as well as face- to- face according to your feasibility. However, in some of the instances (if I am in UK), the preferred method would be through telephone. Interviews will be conducted by the lead investigator (Amal Alaswad). You will be given an opportunity to discuss and share your views/opinions regarding barriers and facilitators of electronic health record implementation in your organisation. Additionally, you would be given possible solutions to overcome such barriers. There will be no right or wrong answer and all types of opinions and suggestions would be welcomed and will be given equal consideration.

7. What do I have to do?

You do not need to change your routine activities and schedule. This participation does not impose any type of restriction at all, before or after interview so you should not worry in this regard.

8. What are the possible disadvantages and risks of taking part?

There is no foreseeable risk of physical or psychological harm to participants.

9. What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the research, it is hoped that this work will help the ministry of health (MOH), Saudi Arabia to design policies accordingly to make this transition process smoother. You can also indicate if you would like to receive the results from this work, if so, they will be provided to you.

10. What happens if the research study stops earlier than expected?

If the research study stops earlier than expected then in this case the reason(s) will be explained to the participants.

11. What if something goes wrong?

If you have any query/complaint you can contact me without hesitation at my given contact number. However, if you feel that I could not handle your query/complaint appropriately then you can contact my supervisor Dr. Simon Brownsell at (s.brownsell@sheffield.ac.uk).

12. Will my taking part in this project be kept confidential?

All the information that you will provide/share during interview will be password protected and hard copies kept in locked cupboards. I will use the information anonymously (participant's name or personal identity will not be used; instead a unique ID will be given for research purpose). Data will also be analyzed anonymously by using that unique ID. Similarly, this anonymity will also be maintained during report/paper writing, presentation and publication by not using personal identity/name.

13. What type of information will be sought from me and why is the collection of this information relevant for the achievement of the research project's objectives?

In interview, you will be asked questions about the barriers, and facilitators of electronic health record implementation in hospitals of Saudi Arabia. Additionally, I am looking for possible solutions to overcome those barriers. You can give your opinions and suggestion in light of your experience. There will be no right or wrong answer and all types of opinions and suggestions would be welcomed and will be given equal due respect. This information should assist the ministry of health (MOH), Saudi Arabia to design policies accordingly to make this transition process smoother.

14. Will I be recorded, and how will the recorded media be used?

The interview will be audio recorded in order to catch all necessary details being provided in discussion. This is important in order to avoid missing any information. The voices will be transcribed to produce a transcript and destroyed after the studies are completed. The tape will not be shared with any individual outside the research team. Prior to submission of the final report the tape will be kept in locked cupboards. I will analyze data of the interview anonymously (no name or personal identity) and you will not be mentioned in the final report or any publication.

15. What will happen to the results of the research project?

Results of the study will be submitted to the University of Sheffield by the end of 2014. Participants will not be identified in any report or presentation or publication. Findings of the study will also be shared with the government through the MOH.

16. Who is organising and funding the research?

This study is being conducted as a postgraduate research project. The study is sponsored by the government of KSA.

17. Who has ethically reviewed the project?

This research has received ethical approval from Ethics Committee of School of Health and Related Research (ScHARR) at University of Sheffield, UK and Ministry of health in Suadi-Arabia.

18. Contact for further information

My contact information is given below. If you have any query or need further information you can contact me without hesitation. I am very thankful for your time and cooperation.

Best Wishes

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A1.2: Guideline for semi-structure interview

Interviewer:	Amal Alaswad
Interviewee:	Decision makers
Age:	No limit
Sex:	Males & Females
AA:	Amal Alaswad
P:	Participant

Interview will be conducted according to your availability and choice of participant in terms of place and time. However, a quite, silent and undisturbed place would be preferable. It would be easier for interviewer and interviewee to communicate with each other. A Digital recorder will be positioned with telephone in such a way that it should ensure quality of sound.

Interview will be started with a formal introduction of each other. The purpose of the study and interview will be explained briefly. Key instructions will be read and explain to participants. At the end of the interview, I will thank the participant and will acknowledge their participation. They will be assured regarding privacy and confidentiality of information that they have shared with me.

Discussion will be carried out about the barriers, and facilitators of electronic health record implementation in hospitals of Saudi Arabia. Additionally, there will be discussion about possible solutions to overcome those barriers. Participants will be given the opportunity to express their opinion on given aspects in any order.

A1.3: Key Instructions for participants:

- Participants will have right to express their opinion and experiences freely.
- There is no right or wrong answer for any point.
- Participants are free to ask explanation of any point/question if it is not clear to them.
- Participant will be asked to maintain tone of their voice loud enough to be recorded.

A1.3.1: Consent form for interview participants

Title of Research Project: Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals (MoH) in Kingdom Saudi Arabia		
Name of Lead Researcher: Amal Alaswad	**Participant Identification Number:**	
S. No	**Statement**	**Please initial box**
1	I confirm that I have read and understand the information sheet version-I explaining the above research project and I have had the opportunity to ask questions about the project.	
2	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
3	I understand that I will be given an opportunity to discuss and share my views/opinions regarding barriers, facilitators and potential solutions for electronic health record implementation.	
4	I understand that interview will be audio recorded **and transcribed, w**hich is absolute necessity for research purpose.	
5	I understand that principal investigator will keep my responses strictly confidential. **I give permission for members of the research team to have access to my anonymised responses**. I understand that my name will not be identified or identifiable in the report or reports that result from the research.	
6	I agree to take part in the above research project.	

______________________ ______________________ ______________________

Name of Participant Date Signature

____________________ ____________________ ____________________

Lead Researcher Date Signature

A1.4: Interview agenda (Decision makers)

A1.4.1: In English

1. What were the main business problems the organisation faced before adopting EHR?

2. What are the main motivations for adopting EHR?

3. Who initiated the idea of adopting EHR?

4. Did you use any evaluation tools for EHR systems before the adoption process? Please explain.

5. Have you carried out any consultations with regard to EHR systems and market? If yes, what impact did the consultants have on the adoption of EHR?

6. How did the actual state of affairs regarding the uncertainty of the national market of health IT applications impact on the decision-making to adopting EHR system?

7. What is the overall cost of the adoption and implementation of EHR?

8. What impact does prior knowledge of these costs have on the adoption of EHR?

9. Did you implemented EHR at once or based on stages?

10. At what stage your EHR is based on HIMSS model?

11. What are the different criteria being used for the selection of a specific stages and components of EHR?

12. What are the main characteristics or aspects of EHR that must be taken into consideration before the adoption process? In your opinion, how can healthcare organisations predict and respond to these aspects effectively and efficiently before the adoption process?

13. What are your roles in the adoption and implementation process?

14. Were there any concerns about the current IT infrastructure before adopting EHR?

15. How are the EHR adoption and implementation process being supported at the organisational level?

16. What was the impact of the adoption of EHR at the organisational level?

17. Can you specify the general benefits derived from the EHR in the organisations?

18. Can you specify the different challenges and barriers to the adoption and implementation of EHR? What solutions are being introduced to overcome these barriers?

19. Have any activities (e.g. promotion and awareness-raising, pilots and demonstrations, sponsorship, information and technical support, resource allocation, vendor support, consultant support and government support … etc) been carried out by the government and/or other parties to encourage and support the adoption of EHR in Saudi hospitals? Please explain.

20. In your opinion, what the governmental factors are likely to influence the adoption process of EHR in the hospitals in Saudi Arabia? In your opinion, what solutions can overcome other governmental and environmental barriers to the adoption of EHR systems in Saudi Arabia?

A1.4.2: Translated into Arabic

<u>أجندة المقابلة الشخصية (صناع القرار)</u>

1- ما هي أهم المشاكل التي واجهتها المنشأة قبل تطبيق السجلات الطبية الالكترونية؟
2- ما هي أهم الدوافع لتبني نظام السجلات الطبية الالكترونية؟
3- من هو صاحب فكرة تبني نظام السجلات الطبية الالكترونية؟
4- هن استخدمت أي أدوات لتقييم أنظمة السجلات الطبية الالكترونية قبل البدء في عملية تطبيق السجلات الطبية الالكترونية؟ رجاء التوضيح.
5- هل أجريت استشارات بخصوص أنظمة السجلات الطبية الالكترونية وبخصوص السوق؟ إذا كانت الإجابة نعم، ما هو تأثير هذه الاستشارات على تبني نظام السجلات الطبية الالكترونية؟
6- كيف أثر عدم وضوح الواقع الحقيقي للسوق الوطني لتطبيقات تقنية الحاسب الآلي على قرار تبني نظام السجلات الطبية الالكترونية؟
7- كم التكلفة الإجمالية لتبني وتطبيق نظام السجلات الطبية الالكترونية؟
8- ما هو أثر المعرفة المسبقة عن التكلفة الاجمالية على تبني نظام السجلات الطبية الالكترونية؟
9- هل طبقت نظام السجلات الطبية الالكترونية فوراً وبالكامل أم كان التطبيق على مراحل؟
10- باستخدام مراحل تطبيق نظام السجلات الطبية الالكترونية حسب نموذج الجمعية الأمريكية لأنظمة المعلومات الصحية والإدارة، ما هي المرحلة الحالية التي وصل إليها مستشفاكم ؟
11- ما هي المعايير التي يستخدمها مستشفاكم لاختيار مراحل وعناصر محددة من نظام السجلات الطبية الالكترونية؟
12- ما هي المواصفات أو الجوانب الرئيسة لنظام السجلات الطبية الالكترونية التي يجب أن تؤخذ في الاعتبار قبل تبني هذا النظام؟ في رأيك كيف يمكن للمنشآت الصحية معرفة هذه المواصفات والتعامل معها بكفاءة وفاعلية قبل عملية التطبيق؟
13- ما هو دورك في تبني وتطبيق نظام السجلات الطبية الالكترونية ؟
14- هل كانت هناك مخاوف بخصوص البنية التحتية لتقنية المعلومات قبل تطبيق نظام السجلات الطبية الالكترونية؟

15- كيف يتم الدعم على مستوى المستشفى لتبني وتطبيق السجلات الطبية الالكترونية؟

16- ما هو أثر تطبيق السجلات الطبية الالكترونية على مستوى المستشفى؟

17- هل يمكنك أن تعدد الفوائد العامة لتطبيق السجلات الطبية الالكترونية في المستشفى؟

18- هل يمكنك أن تعدد التحديات والمعوقات لتطبيق السجلات الطبية الالكترونية في المستشفى؟ ما هي الحلول التي تم اتخاذها لمعالجة هذه المعوقات؟

19- هل تم اتخاذ أي إجراءات بواسطة الحكومة والجهات الأخرى ذات العلاقة (مثل: التطوير ورفع الوعي، التجارب العملية والعرض العملي، الرعاية، الدعم المعلوماتي والفني، توفير الموارد، دعم البائع، الدعم الاستشاري والحكومي ... الخ) لتشجيع ودعم تبني السجلات الطبية الالكترونية في مستشفيات المملكة؟ رجاء التوضيح.

20- في رأيك، ما هي العوامل الحكومية التي يمكن أن تؤثر على عملية تبني السجلات الطبية الالكترونية في مستشفيات المملكة العربية السعودية؟ في رأيك، ما هي الحلول التي يمكن أن تساعد في معالجة المعوقات الحكومية والبيئية التي تعوق تبني نظام السجلات الطبية الالكترونية في المملكة العربية السعودية؟

A2: Focus Group Documents

A2.1:Guide for Focus Group Discussion (FGDs)

For focus group discussion, a U-shaped sitting arrangement will be preferred so that all participants can see and listen to each other. The session will be audio recorded and for this purpose, tape recorder will be positioned in centre of tables.

Before starting the focus group discussion (FGDs), a formal verbal consent will be obtained from participants. All participants will be asked to introduce each other. Thereafter, principal investigator will explain the purpose of session and will take formal permission of using tape recorder. At end, session will be concluded by principal investigator who will also assure participants regarding their privacy and confidentiality of information.

Discussion will carried out on “Issues of Electronic Health Records’ Adoption and Usage in Ministry of Health Hospitals (MoH) in Kingdom Saudi Arabia”. Participants will be getting opportunity to express their opinion on following and/or other relevant points in any order.

Note: Refreshment will be provided to participants during the session.

A2.2 Key Instructions for participants

- All participants have equal right to share their opinion and experiences.
- There is no right or wrong answer.
- If anything is not clear, participants are free to ask explanation.
- It would be essential for participants to maintain dignity of other participants.
- Participants will be requested to wait for their turn to speak.
- Participants will be asked to keep their voice loud enough so that other can hear them.

A2.3Focus Group Questions

A2.3.1: In English

1. When, who and how was the idea of adopting EHR initiated?
2. To what extent is the adoption and the implementation of EHR successful in the hospital?
3. To what extent is the quality of medical services being improved by the EHR in the hospitals?
4. Are there any safety, security and confidentiality concerns with the use of EHR?
5. To what extent did the EHR satisfy and meet the general organisational, operational managerial issues and needs?
6. Were the medical staff involved in the decision-making of the adoption process of EHR?
7. Were the medical staff involved in the implementation process of EHR?
8. Were there any awareness-raising campaigns during the adoption and implementation process?
9. Has the hospital provided practical training sessions to the medical staff on the use of EHR?
10. Are there any technical, organisational and managerial supports to encourage the use of EHR in daily routine?
11. Have you received any incentives for using EHR in your daily routine work?
12. What are the main challenges facing the medical staff in maintaining the EHR in the daily routine at both the organisational and national level? If there are challenges, what solutions do you suggest to effectively overcome those challenges?
13. How the multilingualism and the differences in the level of IT knowledge and skills among the medical staff affect the use of electronic health records in hospitals?

A2.3.2: Translated into Arabic

أسئلة مجموعة الاهتمام

1- من هو صاحب فكرة السجلات الطبية الالكترونية ومتى وكيف كان ذلك؟

2- إلى أي مدى كان تطبيق السجلات الطبية الالكترونية ناجحاً في المستشفى.

3- إلى أي مدى تحسنت جودة الخدمات الطبية باستخدام السجلات الطبية الالكترونية في المستشفى؟

4- هل توجد أي مخاوف بخصوص السلامة والأمن والسرية مع استخدام السجلات الطبية الالكترونية؟

5- إلى أي مدى تلبي السجلات الطبية الالكترونية الاحتياجات التنظيمية والتشغيلية والإدارية للمستشفى؟

6- هل تم إشراك الأطباء في اتخاذ القرار المتعلق بتبني استخدام السجلات الطبية الالكترونية في المستشفى؟

7- هل تم إشراك الأطباء في عملية تطبيق السجلات الطبية الالكترونية في المستشفى؟

8- هل كانت هناك حملات توعوية للعاملين أثناء عملية تبني وتطبيق نظام السجلات الطبية الالكترونية في المستشفى؟

9- هل قدم المستشفى دورات تدريبية للأطباء عن كيفية استخدام السجلات الطبية الالكترونية؟

10- هل يوجد تشجيع ودعم فني وتنظيمي وإداري لجعل استخدام السجلات الطبية الالكترونية روتين العمل اليومي بالمستشفى؟

11- هل استلمت أي حوافز مقابل استخدامك للسجلات الطبية الالكترونية في روتين عملك اليومي؟

12- ما هي التحديات الرئيسية التي تواجه الأطباء في الإبقاء على السجلات الطبية الالكترونية كروتين للعمل اليومي على مستوى المستشفى أو على المستوى الوطني؟ في اعتقادك ما هي أنجع الحلول لمعالجة هذه التحديات؟

13- كيف يؤثر تعدد لغات الأطباء واختلاف مستوى معرفتهم بتقنية المعلومات في تطبيق السجلات الطبية الالكترونية في المستشفى؟

A3: Questionnaires

A3.1: Pilot study Questionnaire used in the pilot study

A3.1.1: The English Version

Instructions for completing the questionnaire

Please read each question carefully.

There are no right or wrong answers.

The questionnaire is divided into three sections (A, B, C, D). Section A asks for general information about the hospital where you work. Section B asks for information about the hospital information technology department. Section C asks about the components of electronic health records, and the last section, Section D asks questions about the process of adopting and implementing electronic health records.

<table>
<tr><td colspan="4">A) General Information</td></tr>
<tr><td>Your age:</td><td colspan="2">Your gender:</td><td>Years of experience working in a hospital:</td></tr>
<tr><td>Hospital Name:</td><td colspan="2">Hospital City:</td><td>Hospital Region:</td></tr>
<tr><td colspan="2">Number of beds:</td><td colspan="2">Number of employees:</td></tr>
<tr><td colspan="2">Number of doctors:</td><td colspan="2">Number of other staff:</td></tr>
<tr><td colspan="3">The hospital is: ☐ self-operated OR ☐ company-operated</td><td>Year hospital was founded:</td></tr>
<tr><td colspan="4">B) Hospital IT Department Information</td></tr>
<tr><td colspan="4">The IT department is: : ☐ self-operated OR ☐ company-operated</td></tr>
<tr><td colspan="4">The IT systems are: : ☐ outsourced OR ☐ in-house developed</td></tr>
<tr><td colspan="2">Year IT department was formed:</td><td colspan="2">Number of staff in IT department:</td></tr>
<tr><td colspan="4">What is the percentage of IT professionals to the total IT department staff?
☐ <10% ☐ 10% - 20% ☐ 21% - 30% ☐ 31% - 40% ☐ 41% - 50%
☐ 50% - 60% ☐ 61% - 70% ☐ 71% - 80% ☐ 81% - 90% ☐ ≥91%</td></tr>
</table>

C) Types of electronic systems: Please tick one box

	Which types of electronic health records (EHR) exist in the hospital?	Fully Installed	Partially Installed	Installation planned but not installed	No plan for installation
1	Laboratory	☐	☐	☐	☐
2	Pharmacy	☐	☐	☐	☐
3	Radiology	☐	☐	☐	☐
4	Clinical data repository (CDR)	☐	☐	☐	☐
5	Clinical documentation	☐	☐	☐	☐
6	Nursing notes	☐	☐	☐	☐
7	Disease Registry	☐	☐	☐	☐
8	Integrated Dictation System	☐	☐	☐	☐
9	Emergency department system	☐	☐	☐	☐
10	Ambulatory practice system	☐	☐	☐	☐
11	Intensive Care Unit (ICU) system	☐	☐	☐	☐
12	Remote patient monitoring—ICU	☐	☐	☐	☐
13	Electronic medication administration record (eMAR)	☐	☐	☐	☐
14	Computerized Practitioner/Physician Order Entry (CPOE)	☐	☐	☐	☐
15	Clinical decision support	☐	☐	☐	☐
16	Bar coding	☐	☐	☐	☐

D) The adoption process: Please tick one box

SN	Topic	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
1	EHR systems are easy to use:	☐	☐	☐	☐	☐
2	EHR used in the hospital meet my needs:	☐	☐	☐	☐	☐
3	EHR systems used are compatible with hospitals procedures, standards and policies:	☐	☐	☐	☐	☐
4	There have been benefits in terms of quality of care, patient safety and business enhancement as a result of using HER	☐	☐	☐	☐	☐
5	There has been organisational support for the introduction of EHR systems (for example technical support, managerial support, training, awareness campaigns, or incentives to use):	☐	☐	☐	☐	☐

What are the most significant barriers to successfully implementing electronic health records in your hospital?

____

What are the main factors which have helped implementation of electronic health record systems in your hospital?

MANY THANKS FOR TAKING PART IN THIS SURVEY

A3.2.2: The Arabic Version

الاستقصاء

فضلاً اقرأ كل سؤال بعناية واهتمام قبل الإجابة عليه

لا توجد إجابة صحيحة كما لا توجد إجابة خطأ

ينقسم هذا الاستبيان إلى أربعة أقسام (أ، ب ، ج، د). القسم (أ) يحتوي أسئلة معلومات عامة عن المستشفى. القسم (ب) يحتوي أسئلة تتعلق بقسم تقنية المعلومات. القسم (ج) يحتوي أسئلة عن مكونات السجلات الطبية الالكترونية. أما القسم (د) فإنه يشمل أسئلة عن تطبيق السجلات الإلكترونية.

(أ) معلومات عامة:		
العمر:	النوع:	سنوات الخبرة في العمل بمستشفى:
اسم المستشفى:	المدينة التي يوجد بها:	المنطقة التي يوجد بها:
عدد الأسرة بالمستشفى:	عدد العاملين بالمستشفى:	
عدد الأطباء بالمستشفى:	عدد العاملين من غير الأطباء:	
سنة تأسيس المستشفى:	جهة المشغلة للمستشفى: تشغيل وزاره ☐ تشغيل بواسطة شركة ☐	
(ب) معلومات عن قسم تقنية المعلومات بالمستشفى		
الجهة المشغلة لنظام تقنية المعلومات في المستشفى: تشغيل ذاتي ☐ تشغيل بواسطة شركة ☐		
الجهة التي عملت نظام تقنية المعلومات: جهة من خارج المستشفى ☐ جهة من داخل المستشفى ☐		
عدد العاملين بقسم تقنية المعلومات:	سنة تأسيس قسم تقنية المعلومات:	
ما هي النسبة المئوية لمحترفي تقنية المعلومات بالنسبة لكل العاملين بقسم تقنية المعلومات بالمستشفى؟ أقل من 10% ☐ 10% - 20% ☐ 21% - 30%☐ 31% - 40% ☐ 41% - 50% 51% - 60%☐ 61% - 70%☐ 71% - 80%☐ 81% - 90%☐ 91% - فأكثر☐		

(ج) أنظمة السجلات الطبية الإلكترونية ومستوى تركيبها بالمستشفى: فضلاً حدد إجابة واحدة.

	ما هو مستوى تطبيق أنظمة السجلات الطبية الإلكترونية التالية بالمستشفى؟	تركيب كامل	تركيب جزئي	توجد خطة للتركيب لم تنفذ	لا توجد خطة للتركيب
1	الصيدلية	☐	☐	☐	☐
2	المختبر	☐	☐	☐	☐
3	الأشعة	☐	☐	☐	☐
4	مستودع البيانات السريرية	☐	☐	☐	☐
5	التوثيق الطبي	☐	☐	☐	☐
6	ملاحظات التمريض	☐	☐	☐	☐
7	سجل الأمراض	☐	☐	☐	☐
8	نظام الإملاء المتكامل	☐	☐	☐	☐
9	نظام قسم الطوارئ	☐	☐	☐	☐
10	نظام العيادات الخارجية	☐	☐	☐	☐
11	نظام وحدة العناية المركزة	☐	☐	☐	☐
12	نظام مراقبة المريض عن بعد بالعناية المركزة	☐	☐	☐	☐
13	سجل إدارة الدواء الإلكتروني	☐	☐	☐	☐
14	نظام إدخال أوامر الطبيب إلكترونياً	☐	☐	☐	☐
15	نظام دعم القرار السريري	☐	☐	☐	☐
16	نظام الباركود	☐	☐	☐	☐

(د) عملية تطبيق تطبيق نظام السجلات الطبية الإلكترونية بالمستشفى: فضلاً حدد إجابة واحدة.

ما هو نوع نظام السجلات الطبية الإلكترونية الذي يوجد في المستشفى؟		**أوافق بشدة**	**أوافق**	**لا أوافق ولا أعارض**	**أعارض**	**أعارض بشدة**
1	نظام السجلات الطبية الإلكترونية سهل تطبيقه	☐	☐	☐	☐	☐
2	نظام السجلات الطبية الإلكترونية المستخدم يلبي احتياجاتي	☐	☐	☐	☐	☐
3	نظام السجلات الطبية المستخدم متوافق مع المعايير والسياسات والإجراءات الخاصة بالمستشفى	☐	☐	☐	☐	☐
4	استخدام السجلات الطبية الإلكترونية حقق فوائد فيما يتعلق بتحسين جودة الرعاية الصحية وسلامة المرضى وتوسعة العمل	☐	☐	☐	☐	☐
5	هناك دعم تنظيمي لتطبيق أنظمة السجلات الطبية الإلكترونية بالمستشفى (مثلاً الدعم الفني، الدعم الإداري، التدريب، حملات التوعية، دوافع الاستخدام)	☐	☐	☐	☐	☐

ما هي أهم معوقات التطبيق الناجح لنظام السجلات الطبية الإلكترونية في مستشفاكم؟
ما هي أهم العوامل التي ساعدت في تطبيق نظام السجلات الطبية الإلكترونية في مستشفاكم؟

نشكركم جزيل الشكر لمساهمتكم القيمة في هذه الدراسة

A3.3: Case Study Questionnaire used in the case studies

A3.3.1: English Version

Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals in Saudi Arabia

This survey asks for your opinions about the implementation of the Electronic Health Records in your hospital. It will take about 15 to 20 minutes of your time to complete.

<u>A. Background Information</u>

This information will help in the analysis of the survey results.

1. **Gender?**

☐ a. Male ☐ b. Female

2. **Age?**

☐ a. Less than 30 years ☐ c. 40 to 49 years
☐ b. 30 - 39 years ☐ d. 50 years or more

3. **What is your highest education level? Select one answer.**

☐ a. Less than diploma ☐ d. Bachelor
☐ b. Diploma ☐ e. Postgraduate

4. **What is your staff position in this hospital? Select ONE answer that best describes your staff position.**

☐ a. Physician/Dentist
☐ b. Nurse
☐ c. Pharmacist
☐ d. Radiologist
☐ f. Non-physician health specialist (dietician, social worker …)
☐ g. Health technician (e.g., Radiology, Lab, Rehab. ….)
☐ h. Administrative specialist (statistics, personnel, accountant …)
☐ i. Administrative staff (e.g., Clerk/Secretary/Receptionist ……)
☐ j. Other, please specify:

Definition of Electronic Medical Records (EMR): computerised patient records/information about patients which is available to staff in the hospital.

5. What medical record system have you used mostly before the current system?

- ☐ a. Manual
- ☐ b. Electronic

6. if you have used Electronic Medical Record System before this system, for how long have you used it?

- ☐ a. less than 6 months
- ☐ b. 06 – 12 months
- ☐ c. 13 – 18 months
- ☐ d. 19 – 24 months
- ☐ e. more than 24 months

7. What computer applications can you use? Please select all applicable answers.

- ☐ a. Microsoft Office
- ☐ b. Excel
- ☐ c. PowerPoint
- ☐ d. Access
- ☐ e. Internet
- ☐ f. Other, please specify:

8. How do you rate your computer knowledge and skills?

- ☐ a. Very poor
- ☐ b. Poor
- ☐ c. Average
- ☐ d. Good
- ☐ e. Very Good
- ☐ f. Excellent

9. How long have you worked in your current specialty or profession? Please select one answer.

- ☐ a. Less than 2 years
- ☐ b. 2 to less than 5 years
- ☐ c. 5 to less than 10 years
- ☐ d. 10 to less than 15 years
- ☐ e. 15 to less than 20 years
- ☐ f. 20 years or more

<u>Please indicate your agreement or disagreement with the following statements about your hospital.</u>

B. User's Attitude:

Think of how you perceive the use of an electronic medical record system in the hospital	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
10. Using electronic medical record systems in the Hospital is important for me to do my job in an efficient and effective manner.	☐1	☐2	☐3	☐4	☐5
11. Using electronic medical record systems in the Hospital is better than using manual records	☐1	☐2	☐3	☐4	☐5
12. using electronic medical record systems in the hospital is more helpful.	☐1	☐2	☐3	☐4	☐5
13. if I had to chose between the electronic medical record and the manual, I would chose the electronic.	☐1	☐2	☐3	☐4	☐5

<u>C. Characteristic of the Current Information System</u>

Think of how you perceive the* electronic medical record systems *that is currently used in your department	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
14. The current electronic medical record system in our department is adequate	☐1	☐2	☐3	☐4	☐5
15. The current electronic medical record system in our department is flexible	☐1	☐2	☐3	☐4	☐5
16. The current electronic medical record system in our department is easy to learn and operate	☐1	☐2	☐3	☐4	☐5

17. The current electronic medical record system in our department is stimulating	☐1	☐2	☐3	☐4	☐5
18. The current electronic medical record system in our department is satisfying	☐1	☐2	☐3	☐4	☐5
19. The current electronic medical record system in our department is wonderful	☐1	☐2	☐3	☐4	☐5
20. The current electronic medical record system in our department increases my productivity	☐1	☐2	☐3	☐4	☐5
21. The current electronic medical record system in our department increases the quality of my work	☐1	☐2	☐3	☐4	☐5

D. Impact of Technology

Think of how the technology impacts patient safety and quality of care	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
22. Using an electronic medical record system in the hospital makes my day-to-day work easier	☐1	☐2	☐3	☐4	☐5
23. I feel relaxed when I am using an electronic medical record system	☐1	☐2	☐3	☐4	☐5
24. Using an electronic medical record system in my work is faster than using manual records	☐1	☐2	☐3	☐4	☐5
25. Using an electronic medical record system in my work has helped to improve staff communication	☐1	☐2	☐3	☐4	☐5
26. Using an electronic medical record system in the hospital has improved work efficiency in the department	☐1	☐2	☐3	☐4	☐5
27. Using an electronic medical record system in the hospital helps to improve the quality of patient care	☐1	☐2	☐3	☐4	☐5

28. Using an electronic medical record system in the hospital helps to decrease medical errors	☐1	☐2	☐3	☐4	☐5
29. Using an electronic medical record system in the hospital helps to decrease the number of unnecessary medical tests	☐1	☐2	☐3	☐4	☐5
30. Using an electronic medical record system in the hospital helps to enhance confidentiality of patient's information	☐1	☐2	☐3	☐4	☐5
31. Using an electronic medical record system in the hospital helps to increase patient's privacy	☐1	☐2	☐3	☐4	☐5

E. Environmental Characteristics

Think about how the work environment encourages or hinders the use of electronic medical record systems	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
32. The hospital top management is committed to and supportive of the use of the electronic medical record system in the hospital.	☐1	☐2	☐3	☐4	☐5
33. In the hospital, senior managers are helpful in facilitating the use of the electronic health records systems	☐1	☐2	☐3	☐4	☐5
34. Adequate training in the use of electronic records systems is given to the staff	☐1	☐2	☐3	☐4	☐5
35. Currently the computers are adequate in the hospital	☐1	☐2	☐3	☐4	☐5
36. Users are involved in the process of developing electronic records systems for the hospital	☐1	☐2	☐3	☐4	☐5

F. Your Comments

Process of implementation of Electronic Medical Records systems in your hospital.

37. In your view what helps electronic medical records systems to work in your hospital?
38. In your view what hinders electronic medical records systems to work?
39. In your view what are the critical factors for selecting a good electronic medical records systems for hospitals?

THANK YOU FOR COMPLETING THIS SURVEY.

A3.3.2: Arabic Version

الأمور المتعلقة بتبني واستخدام السجلات الطبية الالكترونية في مستشفيات وزارة الصحة بالمملكة العربية السعودية

هذا الاستبيان يهدف لمعرفة رأيكم في تطبيق السجلات الطبية الإلكترونية في المستشفى الذي تعمل به. تعبئة هذا الاستبيان تستغرق حوالي 15 – 20 دقيقة من وقتكم الغالي. نأمل التكرم لطفاً باستيفاء المطلوب للمساهمة في تحقيق أهداف هذه الدراسة.

(أ). المعلومات الشخصية:

هذه المعلومات ضرورية وتساعد في تحليل النتائج.

1- الجنس؟

☐ ذكر ☐ أنثى

2- العمر؟

☐ أقل من 30 سنة ☐ 40 – 49 سنة

☐ 30 – 39 سنة ☐ 50 سنة فأكثر

3- الدرجة العلمية؟ رجاء اختيار أعلى درجة حصلت عليها

☐ أقل من دبلوم ☐ بكالوريوس

☐ دبـــــــــلوم ☐ ماجستير/دكتوراة

4- ماهي وظيفتك في المستشفى؟ رجاء اختيار إجابة واحدة فقط

☐ طبيب ☐ أخصائي صحي غير طبيب (تغذية، خدمة اجتماعية .....)

☐ ممرض/ممرضة ☐ فني صحي (أشعة، مختبر، صيدلة، علاج طبيعي ...)

☐ صيدلي ☐ أخصائي إداري (شؤون موظفين، إحصاء، محاسب ... الخ)

☐ أخصائي أشعة ☐ إداري (كاتب/سكرتير/ناسخ ....)

☐ أخرى (تذكر: ....

تعريف السجلات الطبية الإلكترونية: هي السجلات والمعلومات الإلكترونية الخاصة بالمرضى والمتاحة عن طريق الحاسب الآلي للعاملين بالمستشفى.

5- ما هو نظام السجلات الطبية الذي كنت تستخدمه في العمل قبل النظام الحالي؟

☐ يدوي ☐ إلكتروني

6- إذا استخدمت نظام السجلات الطبية الإلكترونية قبل هذا النظام فما هي المدة التي استخدمته فيها؟

☐ أقل من 6 شهور ☐ 18 – 24 شهر

☐ 6 – 12 شهر ☐ أكثر من 24 شهر

☐ 13 – 18 شهر

7- ما هي تطبيقات الحاسب الآلي التي تستخدمها؟ رجاء اختيار كل الإجابات المناسبة

☐ مايكروسوفت أوفيس ☐ اكسس

☐ اكسل ☐ انترنت

☐ بوربوينت ☐ أخرى، تذكر: ....

8- ما هو تقييمك لمستوى معرفتك ومهاراتك في استخدام الحاسب الآلي؟

☐ ضعيفة جداً ☐ جيدة

☐ ضعيفة ☐ جيدة جداً

☐ متوسطة ☐ ممتازة

9- كم عدد سنوات خبرتك في الوظيفة أو التخصص الحالي؟ رجاء اختيار إجابة واحدة فقط

☐ أقل من سنتين ☐ 10 سنوات إلى أقل من 15 سنة

☐ سنتين إلى أقل من 5 سنوات ☐ 15 سنة إلى أقل من 20 سنة

☐ 5 سنوات إلى اقل من 10 سنوات ☐ 20 سنة فأكثر

رجاء تحديد مدى إتفاقك أو أختلافك مع الوصف التالي:

(ب)- موقفك الشخصي من استخدام السجلات الطبية الإلكترونية في المستشفى

م	الوصف	أعارض بشدة	أعارض	لا أعارض ولا أوافق	أوافق	أوافق بشدة
	فكر في نظرتك الشخصية تجاه استخدا السجلات الطبية الإلكترونية في المستشفى	▼	▼	▼	▼	▼
10	استخدام السجلات الطبية الإلكترونية في المستشفى ضروري لتمكيني من أداء وظيفتي بكفاءة وفاعلية.	☐1	☐2	☐3	☐4	☐5
11	استخدام السجلات الطبية الإلكترونية في المستشفى أفضل من استخدام السجلات الورقية	☐1	☐2	☐3	☐4	☐5
12	استخدام السجلات الطبية الإلكترونية في المستشفى يعتبر مفيد	☐1	☐2	☐3	☐4	☐5
13	إذا كان علي الاختيار بين السجلات الطبية الإلكترونية والسجلات الورقية فإنني سأختار السجلات الطبية الالكترونية	☐1	☐2	☐3	☐4	☐5

(ج)- خصائص نظام السجلات الطبية الإلكترونية الحالي في قسمك

م	الوصف	أعارض بشدة	أعارض	لا أعارض ولا أوافق	أوافق	أوافق بشدة
	فكر في مزايا وخصائص النظام المستخدم الآن في قسمك	▼	▼	▼	▼	▼
14	نظام السجلات الطبية الإلكترونية الحالي في القسم كافي	☐1	☐2	☐3	☐4	☐5
15	نظام السجلات الطبية الإلكترونية الحالي في القسم مرن	☐1	☐2	☐3	☐4	☐5
16	نظام السجلات الطبية الإلكترونية الحالي في القسم سهل تعلمه وتشغيله	☐1	☐2	☐3	☐4	☐5
17	نظام السجلات الطبية الإلكترونية الحالي في القسم محفز	☐1	☐2	☐3	☐4	☐5
18	نظام السجلات الطبية الإلكترونية الحالي في القسم مريح	☐1	☐2	☐3	☐4	☐5
19	نظام السجلات الطبية الإلكترونية الحالي في القسم رائع	☐1	☐2	☐3	☐4	☐5
20	نظام السجلات الطبية الإلكترونية الحالي في القسم يزيد إنتاجيتي في العمل	☐1	☐2	☐3	☐4	☐5
21	نظام السجلات الطبية الإلكترونية الحالي في القسم يزيد جودة عملي	☐1	☐2	☐3	☐4	☐5

(د)- أثر التقنية

م	**الوصف**	**أعارض بشدة**	**أعارض**	**لا أعارض ولا أوافق**	**أوافق**	**أوافق بشدة**
	فكر في أثر استخدام تقنية الحاسب الآلي على سلامة المرضى وجودة الخدمات	▼	▼	▼	▼	▼
22	استخدام نظام السجلات الطبية الالكترونية في المستشفى يجعل عملي اليومي سهلاً	☐1	☐2	☐3	☐4	☐5
23	أشعر بالراحة عند استخدام نظام السجلات الطبية الالكترونية	☐1	☐2	☐3	☐4	☐5
24	استخدام نظام السجلات الطبية الالكترونية في المستشفى أسرع من استخدام السجلات الورقية	☐1	☐2	☐3	☐4	☐5
25	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تحسين التواصل بين العاملين	☐1	☐2	☐3	☐4	☐5
26	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تحسين الكفاءة في القسم	☐1	☐2	☐3	☐4	☐5
27	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تحسين جودة الرعاية الصحية للمرضى	☐1	☐2	☐3	☐4	☐5
28	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تقليل عدد الأخطاء الطبية	☐1	☐2	☐3	☐4	☐5
29	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تقليل عدد الفحوص الطبية غير الضرورية	☐1	☐2	☐3	☐4	☐5
30	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تحسين سرية معلومات المرضى	☐1	☐2	☐3	☐4	☐5
31	استخدام نظام السجلات الطبية الإلكترونية في المستشفى ساعد في تحسين خصوصية المرضى	☐1	☐2	☐3	☐4	☐5

(هـ)- خصائص البيئة:

م	**الوصف**	**أعارض بشدة**	**أعارض**	**لا أعارض ولا أوافق**	**أوافق**	**أوافق بشدة**
	فكر في تأثير بيئة العمل من حيث تشجيع أو إعاقة استخدام نظام السجلات الطبية الإلكترونية في المستشفى	▼	▼	▼	▼	▼
32	الإدارة العليا للمستشفى ملتزمة وداعمة لاستخدام نظام السجلات الطبية الإلكترونية في المستشفى	☐1	☐2	☐3	☐4	☐5
33	رؤساء الأقسام والمشرفين في المستشفى يدعمون ويسهلون استخدام السجلات الطبية الإلكترونية في المستشفى	☐1	☐2	☐3	☐4	☐5
34	يتم توفير تدريب كافي للعاملين على استخدام نظام السجلات الطبية الإلكترونية	☐1	☐2	☐3	☐4	☐5
35	يوجد في المستشفى عدد كافي من أجهزة الحاسب الآلي	☐1	☐2	☐3	☐4	☐5
36	يتم إشراك المستخدمين في تطوير نظام السجلات الطبية الإلكترونية	☐1	☐2	☐3	☐4	☐5

(و) – عملية تطبيق نظام السجلات الطبية الإلكترونية في مستشفاكم

37- من وجهة نظرك ما هي العوامل التي ساعدت مستشفاكم في إنجاح عملية تبني وتطبيق السجلات الطبية الإلكترونية في المستشفى؟
38- من وجهة نظرك ما هي المشاكل التي يمكن أن تعوق نجاح استخدام السجلات الطبية الإلكترونية ؟
39- من وجهة نظرك ما هي العوامل الضرورية لاختيار نظام السجلات الطبية الإلكترونية في المستشفيات؟

شاكرين ومقدرين لكم حسن تعاونكم وتكرمكم واهتمامكم بإكمال بيانات هذا الاستبيان

A Review Paper of the Current Status of Electronic Health Records Adoption Worldwide: The Gap between Developed and Developing Countries

Amal Mohammad AL-ASWAD, Simon BROWNSELL, Rebecca PALMER, Jonathan P. NICHOL

Abstract. This review paper represented a critical literature review of some related studies to the means of electronic health records in addition to their advantages and disadvantages from different perspectives and viewpoints. The main aim of this paper is concluded in reviewing the adoption of electronic health records in different countries in order to trace out the current status of adopting this technology worldwide. Through this paper, some concentration will be done on the adoption of electronic health records at Saudi Arabia since the researcher aims to follow this paper with a research to measure the "adoption of electronic health records at Saudi Arabia". However, this paper will follow a critical review method of the "adoption" of electronic health records starting by its implementation then its distribution worldwide in some countries. This study aims to find the gaps in the literature that are related to the adoption of electronic health records worldwide.

Keywords. Medical Records (MR), Health Records (HR), Paper based Medical Records (PBMR), Electronic Health Records (EHR), Adoption of Electronic Health Records

Introduction

The medical record is an account of the patient which contains information regarding presenting symptoms, with annotations from the physician and other health professionals detailing their observations as well as discussions with the patient [1]. As far as history is concerned, medical records are as old as medicine itself. One of the oldest recorded medical practices is the ancient Egyptian medicine which developed parts of the oldest form of health records. Ancient Egyptians used carvings, drawings and symbols (known as hieroglyphics) on the walls of tombs and temples to document the medical history of the deceased. The hieroglyphics provided information about the illnesses, treatments and operations performed during the life of the deceased [2].

However, the first more formal, medical record was developed in the fifth century B.C by Hippocrates who set two goals for medical records. The first goal was that a medical record should accurately reflect the course of the disease. The second goal was that a medical record should indicate the probable cause of the disease. These two goals are still valid and appropriate for medical records [3]. Similarly, Galen of Pergamon, a Roman physician of Greek origin also made great contributions to anatomy and medicine and was known for documenting his observations about the care he provided to his patients [4].

In the 1890s, hospitals became more organized and began to keep records of patients' admissions and discharges. Massachusetts General Hospital records of admissions started in 1821. In the successive decades, many improvements in standards of professionalism were seen. The American College of Surgeons was formed in 1913 as an educational association for surgeons. The college set high standards for surgical education and practice. These standards led the movement to maintain more comprehensive documentation of medical records. Later on standardization was gradually replaced by accreditation [5].

Today, management of large amount of patient information in medical practice made the medical record the cornerstone of communication and documentation [1]. This patient information is being stored in the form of paper based medical record entirely until early 1960s when the idea of electronic medical record was introduced [6]. Advocacy for the implementation of electronic health record has been seen in last two decades, even today paper-based medical record systems are in practice widely in health care setting [1].

Motivations of this study

The researcher write this paper in order to find out the gap in reviewing the adoption of electronic health records (EHR) in different countries in order to trace out the current status of adopting this technology worldwide. Some focus is done through this paper on the adoption of electronic health records at Saudi Arabia as one of the most developed countries in the Middle East, surely from the developing countries, since the researcher aims to follow this paper with a research to measure the "adoption of electronic health records at Saudi Arabia" by using various kinds of methodologies.

Electronic Health Records (EHR)

There are several terms used in literature interchangeably for electronic health record (EHR) such as electronic medical record (EMR), computer-based patient record (CPR) and electronic patient record (EPR) [7]. Owing to this uncertainty about what exactly constitutes a computer-based medical record, there are several definitions of EHR in the literature. In an attempt to differentiate between EHR and EMR, the National Alliance for Health Information Technology (NAHIT) produces two different definitions. It defines EMR as "*the electronic record of health-related information on an individual that is created, gathered, managed, and consulted by licensed clinicians and staff from a single organisation who are involved in the individual's health and care*", whereas EHR is "*the aggregate electronic record of health-related information on an individual that is created and gathered cumulatively across more than one health-care organisation and is managed and consulted by licensed clinicians and staff involved in the individual's health and care*" [8].

Implementation of Electronic Health Records (EHR)

Transition from paper based-health records (PBHR) to EHR in a health care setting takes time [9; 10]. There are certain factors contribute towards transition time which include; availability of financial support, uncertain return on investment, and standard of technology, level of resistance to change and level of priority for change [11]. In America, in an attempt to create an electronic medical record for most Americans by 2014, the US government established the Office of the National Coordinator for Health Information Technology in 2004 [12]. According to a recent survey by the HIMSS [13], only 1.1% of hospitals are completely paperless whereas nearly 90% of hospitals are at various levels of transition from PBMR to EHR. Similarly, in Canada, no hospital is completely paperless yet but nearly 50% of the hospitals have partial levels of EHR implementation and further efforts from government are being placed for EHR implementation [14].

In the United Kingdom, the NHS set a target in 1998 to have electronic medical records implemented in all its trusts by 2005 [15]. However, in 2002 only 3% of the trusts were found to achieve this target [16]. Budget constraints and lack of required IT standards were the main reasons for this low rate [17]. In response to this, the government allocated £2.3bn for a new national programme for information technology (NPfIT) [18]. Despite critics over the speed of program, the Department of Health advocates the project's potential capability to deliver value for money [19] and according to National Audit Office (NAO) it is expected to be completed by 2016 [20].

As far as other European countries are concerned, a high proportion of electronic medical record is being used at general practitioners (GPs) level. According to a study, the percentage of GPs using electronic medical record in Sweden, the Netherlands, Denmark, Finland, and Austria is 90%, 88%, 62%, 56%, 55% respectively [21]. However, in order to develop cross border EHR implementation, the European Commission launched two electronic health initiatives in twelve member states in 2004 including (i) Smart Open Services (SOS) (ii) Community eHealth Action Plan [22].

The commission aims to achieve and maintain cross-border interoperability of electronic health record systems by the end of the year 2015 [23]. Similarly, according to Department of Health and Aging [24], the Australian government has a plan for a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians. The Government is investing $466.7 million over two years for the (PCEHR) system and the registration will be online, from 2012-13.

Along with developed countries, EHR adoption has also been successfully undertaken in different countries around the world. Two hospitals are now operating as paperless hospitals in Malaysia, eleven hospitals in Korea and a number of hospitals in China are using some form of EHR [25]. Similarly, hospitals in Asia are also in the process of adopting EHR technology [13]. There are number of hospitals in South Korea as well as in Singapore who have successfully implemented EHR systems and set an example for other developing countries [26].

Adoption of Electronic Health Records (EHR) In Different Countries

In the following sections, the adoption of electronic health records is described in certain leading countries of the world such as United Kingdom, European Union countries, United States and Australia.

United Kingdom (UK)

The NHS set a target in 1998 to have EMR implemented in all its trusts by the year 2005, in 2002 only 3% of the trusts were found to achieve the target [15; 16]. Budget constraints and lack of required IT standards were the main reasons for this low rate [17]. In response to this the government allocated £2.3bn for a new national programme for information technology (NPfIT) [18]. It is considered the biggest IT programme in the history of the NHS due to its complexity and size. Its purpose was to develop centrally mandated electronic care records for patients so that nearly 30,000 staff can be connected to 300 hospitals and have secure and audited access to patients' records [27].

However, the NPfIT, like other large-scale programmes around the world; has faced some problems in its implementation [28; 29]. The targets of the original performance are consistently missing in the NPfIT [30; 31]. The strategy to move towards an electronic medical record has not yet reached the expected levels of uptake as a dramatic variation can be seen in the progress of the programme in the different regions, for instance more progress was seen in London whereas there is little progress in other areas e.g. in the North, Midlands and East, just four out of ninety-seven systems have been installed [10; 32]. Based on the poor return of investing £2.7 billion so far on the programme, the NAO does not expect that the remaining planned funding of the £4.3 billion will make any difference in the NPfIT. The NAO concluded that the Programme is failing to represent value for money [31; 19].

The Office of Government Commerce (OGC) Gateway process examines a wide range of projects and programmes to provide assurances that they can make successful progress. It uses independent experts from outside the programme to examine the progress and likelihood of successful delivery of the programme or project. The review provides a valuable perspective on the issues being faced. The Health Gateway Process provides the NHS, DH and its Arm's-Length Bodies (ALBs) with free and confidential support using well established peer review and principles [18]. The Gateway Reviews produced for the NPfIT gave a red code which is the worst status. Nine of the 31 reviews published by the OGC gave the project a red status and called for immediate action to achieve success. Nineteen out of the 31 reviews gave the NPfIT an amber status, which means that the project should proceed whilst taking the OGC recommendations seriously. Only two of the 31 reviews gave the NPfIT the green status, based on their concern about the infrastructure developed for the programme [33]. The NAO attributed the problems to many factors such as: unrealistic ambition, the complex nature of the NHS and problems with technology [31; 19].

Although the NAO has not suggested scrapping the entire scheme, the BBC has mentioned that there are some critics that call for such action. For example, on May 18, 2011, Tory MP Richard Bacon, a member of the House of Commons' Public Accounts Committee said: "This turkey will never fly and it is time the Department of Health faced reality and channelled the remaining funds into something useful that will actually benefit patients". Despite critics, the Department of Health advocates the project's potential capability to deliver value for money [19].

The European Union

Two major electronic health initiatives to develop cross-border EHR have been launched by the European Commission. The aim is to support seamless care to Europeans during their time spent living or travelling abroad. This large-scale project is called Smart Open Services (SOS) and involves 12 member states. The SOS is a step in the direction of pan-European emergency health records that will connect pharmacy systems at the national level. The project will support free health care to citizens in any EU member state. Citizens will be allowed to access their health information stored in the EHR anywhere and at any time. The project will also enable health care providers to access clinical information of patients from other EU member states [22].

According to the European Commission the SOS will ensure compatibility of electronic medical information without the need to develop a common system throughout the EU. The electronic records will be voluntary and will respect the privacy of the citizen. It will be created only upon request from the interested citizen. Although there is no agreement about the contents of the electronic health record, it is expected to include important information such as allergies, medications and blood group [22].

In 2004, the Community eHealth Action Plan identified interoperability of electronic health records as one of the top priorities for Member States in the roadmap to the Action Plan. As a follow-up to the Community eHealth Action Plan, the European Commission drafted in 2008, the recommendation on cross-border interoperability of electronic health record systems. The recommendation aims to enable the free flow of patients as well as eHealth products and services. One of the major obstacles hindering the achievement of the economic and social benefits of eHealth is the lack of interoperability of electronic health record systems across the states. The lack of interoperability has aggravated the existing fragmentation in eHealth. Using incompatible information and communication systems by member states impedes the access to health information that is necessary for providing high quality and safe health care across Europe [23].

The European Commission (2008) recommended to member states a set of guidelines for the deployment of interoperable electronic health record systems that facilitate cross-border exchange of patient health information. Developing such electronic health record systems should provide healthcare providers with a secure and timely access to the vital health information while protecting the patients' rights to confidentiality and privacy. The Recommendation facilitates ePrescription solutions through a set of guidelines for interoperability of emergency data, patient summaries, and medication records [23].

The purpose of the guidelines is to make sure that electronic health records systems in the EU member states can interoperate (communicate to each other) to allow rapid access to vital patient information by health care providers across the EU. The objectives addressed by these guidelines include: establishing features of EHRs that allow exchange of vital patient information between systems; enabling share of health data; building network systems that cover all areas of health care, while meeting operational, legal and training requirements [23].

The Commission aims to achieve and maintain cross-border interoperability of electronic health record systems by the end of the year 2015. According to the Commission, to achieve this, member states are urged to undertake action at five levels: 1) the overall political leaders should make the necessary regulatory and financial environment to make eHealth infrastructure and services interoperable; 2) to create a common domain and interface that enable the national domains to interact; 3) to promote the use of technical standards and develop common interoperability platforms; 4) to agree on common priorities and specific applications; and 5) to improve education and awareness for monitoring and considering all intended and related developments [23].

United States (US)

In an attempt to create an electronic medical record for most Americans by 2014, the US government established the Office of the National Coordinator for Health Information Technology in 2004 to promote and coordinate health information technology. Four goals were identified to guide the adoption of IT in the public and private health care sectors; 1) the adoption of electronic health records; 2) the establishment of a secure national health information network; 3) the use of personal medical records by individual patients;

and 4) the use of research, dissemination of evidence, and quality measurement to improve the public health [12].

Only 1.5% of the American hospitals had implemented comprehensive electronic health records and that 7.6% had basic EHR. An expert panel set criteria for each of the "comprehensive" and "basic" EHR for the purpose of the study. The criteria for the "comprehensive" EHR included 24 functionalities while it included only ten for the "basic". Examples of the functionalities were; physician notes, laboratory reports and medications [34].

Although, progress seems to be slow, the results are considered significant in the light of the 19 billion dollars allocated by Congress for the adoption of EHR and other health information technology. The major barriers to the implementation of electronic health records among US hospitals that did not have EHR included: financial limitations (73%), maintenance costs (44%), cultural barriers (36%), uncertainty about return on investment (32%) and lack of IT training (30%). The study shows that physician resistance and inadequate capital are the major barriers for hospitals seeking to implement EHR [34].

Australia

The National Electronic Health Records Taskforce proposed in 2000 the 'HealthConnect'. It is an IT system funded by the Australian government to allow collection, storage and sharing of health information. The availability of complete and updated electronic health information that can be easily shared by care providers and patients would help decision making and seamless care. The HealthConnect objectives are to improve the effectiveness and efficiency of health care through electronic information that will be collected at the point of care and can be accessed online and shared as needed. The government has established trial sites around the country to test the effectiveness of HealthConnect and learn from these trials [35]. The Federal Enterprise Architecture Framework set policies and standards for the electronic health record that include security, privacy, access control, data control, application and technology [36].

In July 2010, the Computer Sciences Corporation (CSC) conducted an independent study on Australians' views of electronic health records. The research found that consumers see an individual electronic health record as a basic Australian right and they are waiting for the government to deliver it. The research also showed that Australians want to have personal control over their health records and they like to know about its contents and who has access to it [37].

Australia has a plan for a national Personally Controlled Electronic Health Record (PCEHR) system for all Australians. The Government will invest $466.7 million over two years for the (PCEHR) system and the registration will be online, from 2012-13. A draft Concept of Operations document is released to stimulate informed discussion with stakeholders regarding characteristics, design, build and implementation of the PCEHR [24].

Kingdom of Saudi Arabia

Saudi Arabia is one of the rapidly developing countries in the Middle Eastern region. Its total area is 2.15 million Km^2 with a population of approximately 25 million [38]. In Saudi Arabia, 60% of the health care services are provided by the Ministry of Health (MoH) whereas the remaining is provided by other government bodies such as the Ministry of Defence and Aviation, Ministry of Interior, National Guard, University Hospitals and rapidly growing private sector [14].

Most medical record systems in the country are still paper-based and those centres, which have started using electronic medical records, have variations in terms of software and capabilities. Most importantly, most of the electronic medical services are not inter-connected. This situation resulted in fragmented patient information, duplication of work, incomplete data entry and negative effects on the quality, safety and cost of health care [14].

In recent decades, Saudi Arabia has made significant progress in the health sector with several hospitals receiving national and international accreditation, but EHR has not experienced equal progress. Since 2002, Saudi Arabia has shown great interest in adopting EHR to improve the quality of health care, enhance patient safety and reduce the cost of health care services.

In 2004, the King Saud Bin Abdul Aziz University for Health Sciences (KSAU-HS) was created to support ICT in the health care sector. The year 2005 witnessed the establishment of the Saudi Association for Health Informatics (SAHI) to promote health informatics training and education and to support the implementation of the system throughout Saudi Arabia [39]. Similarly, the Central Board for Accreditation of Healthcare Institutions (CBAHI) is a national accrediting body, established in 2007, to promote the quality of health services and increase the degree of safety through accreditation. CBAHI has developed standards for medical records and information management both manual and electronic [40]. Despite these efforts, diffusion of IT applications in Saudi Arabia is still problematic because it is often associated with problems that are not only technical, but that are also cultural, political, economic, educational and social [41].

Taking all situations under consideration, the Saudi MoH initiated a project to automate 30 hospitals in different regions of the country including a unified electronic medical record in 2008. It was found that this project would save 10-15 % of its annual health budget upon the adoption of the EHR system. The project is meant to pave the way for a unified EHR at the national level [42]. Similarly, in 2010 the Saudi Ministry of Health launched its five-year eHealth Strategy for 2011-15 for the Kingdom of Saudi Arabia. The strategy consists of three phases: analysis and vision, strategy design and strategic roadmap. The aim of the first phase is to understand the gap between the current and expected state of the eHealth/ICT. The second phase will include the design of the strategic plan for eHealth/ICT. The final phase is to develop a five-year roadmap for the implementation based on findings from the first two phases [43].

Since MoH has taken initiatives to enhance EHR adoption in healthcare settings in 2008 and 2010, no study has explored the level of EHR adoption at the national level. However, Bah and others [44] evaluated the situation of EHR adoption in the Eastern province of the country and collected the information from 19 out of 244 MoH hospitals. Only three of the hospitals have adopted EHR partially and the level and extent of EHR usage is undetermined despite the commitment of funding from the government [44].

The Adoption of EHRs and related Studies

Health IT systems have the potential to reduce health care costs, improve efficiency, and enhance quality of care and patient safety [45]. One of the promising systems is EHR. While interest in EHRs adoption is high, the rate of EHRs adoption still remains slow in many countries [46]. Many countries have lunched such national programs to move towards a single shared EHR for patients and to connect general practitioner and hospitals [47; 48]. One of the main initiatives of these national programs is to study in depth the different challenges of the adoption of EHRs in those nations [49].

In Saudi Arabia, little is known regarding the adoption of EHRs and in particular within MoH hospitals owing to lack of studies and government roles [50; 44; 14]. According to some few papers concerning health IT systems in Saudi Arabia [50, 44 , 14], there is a concurrent need for such studies to assess the level of EHRs capabilities and adoption within Saudi hospitals. In the context of Saudi Arabia, the concept of EHRs is a relatively new that needs a lot of attention [50; 44].

However, one of the major challenges in identifying the level of EHRs and use is the lack of consensus on what EHRs capabilities mean and constitute [51]. The differences in the definitions used for EHRs and methodological issues in previous studies in the literature might explain the variation in the EHRs adoption rates in some countries such as US or Europe countries [51]. The most appropriate method indicated by many related studies to show the level of EHRs capabilities and adoption in a nation is to use simple percentage into an analytical model to deduce the level of EHR adoption and its. In this regards, most of the previous studies have created either their own analytical model (e.g. consensus among experts to identify functionalities) or asked about the presence or absence of EHRs [34; 52]. However, this will only produce different results and contradictory from one study to another [51].

Another way is the use of an international analytical model that is used by many healthcare institutes and organisations worldwide such as HIMSS Analytics and categorization scheme [44]. HIMSS Analytics and categorization scheme is the most reliable method for assessing the level of sophistication of EHRs capabilities within hospitals today and helps in international comparison of EHR adoption [51; 44].

In the light of the adoption process of EHRs, many studies were found in the literature with the different research approaches, the different explanations [53]. Most of those studies were built based on Rogers' [54] sociology model for the adoption of technology innovations to explain the adoption of EHRs [53; 55].

Rogers' theory explains how individuals or groups learn about innovations and thereafter make their decisions either to adopt or reject the innovation. This theory illustrates five generic innovation characteristics that might influence the adoption of innovation:

Relative Advantage: the degree to which individuals or groups perceive the innovation as superior to existing ones.

Compatibility: the degree to which individuals or groups feel the innovation is consistent with their present needs, values and skills.

Complexity: the degree to which the innovation is easy to understand or use.

Trialability: the degree to which the innovation is experimented with on a limited basis of efforts.

Observability: The degree, to which the innovation's benefits can be observed, imagined or described to the individuals or groups.

Although Rogers' theory is thought to be appropriate, it needs to be expended to better fit the complex EHRs adoption context for several reasons. Rogers' theory defined very broad five generic innovation characteristics which are widely prevalent or generalizable across technologies [53]. In addition, previous studies often subsumed some factors into a single factor of the broad five generic innovation characteristics which reduces the ability to clearly measure and understand the component effect of each factor [53; 56]. Further, every social situation conditioned by interacting variables such as time and culture and therefore no two situations are identical [57] For example, early research of health IT adoption found other factors beside the broad five generic innovation characteristics of Rogers' theory such as the role of hospital and environmental factors (e.g. hospital scale and ownership) in technology adoption decisions [58].

In addition, recent studies reported several issues associated with the adoption of EHRs. For example, governance strategies can successfully address the issues associated with the adoption of EHRs such as cost and patient data security and privacy that can, in other circumstances, act as barriers to the adoption process [59]. Variety of factors attributed to the low rate of EHRs adoption such as macro-level factors (e.g. the lack of national policy and the lack of informatics standards) and the micro-level factors (e.g. individual perceived complexity and resistance from physicians) [53].

Results and Discussion

The implementation and adoption of EHR in throughout the world differ in developing and developed countries. This field is no that new field in the developed countries and their strategies of adoption is drawn from the last century. But in developing countries it appears that the topic should be researched more in future researches in order to cover all its aspects since the implementation of EHR has not distributed all over these countries. From the researcher observations, it appears that the developed countries are looking forward to change all their system to depend on the EHR as the only way of development. But in the developing countries, the main aspect was forwarded to get EHR as a supporter of paper-based health records [60]. The implementation of EHR and its adoption have been reviewed in this paper and it appears that there are some countries from both developed and developing implement and adopt the means of EHR but they does not achieve the desired rate of distribution.

One of the developing countries has been studied through this paper, which is the kingdom of Saudi Arabia, since it is developed in a quick rate comparing with other developing countries. However, it appears that the first step towards implement and adopt EHR was in 2002. But, in some way, very huge gap appear through reviewing related literature for this country, which is the limited number of studies that are covering the topic. Therefore, it is recommended to *make some surveys and studies to cover the topics about the adoption of EHR in Saudi Arabia and its implementation*.

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Our ref: 0533/CAO

12 March 2012

Amal Alaswad
ScHARR

Dear Amal

The transition from paper-based medical records to electronic medical records in hospitals of the ministry of health (MOH), Saudi Arabia

Thank you for submitting the above research project for approval by the ScHARR Research Ethics Committee. On behalf of the University Chair of Ethics who reviewed your project, I am pleased to inform you that on 12 March 2012 the project was approved on ethics grounds, on the basis that you will adhere to the documents that you submitted for ethics review.

The research must be conducted within the requirements of the hosting/employing organisation or the organisation where the research is being undertaken.

If during the course of the project you need to deviate significantly from the documents you submitted for review, please inform me since written approval will be required. Please also inform me should you decide to terminate the project prematurely.

Yours sincerely

Cheryl Oliver
Ethics Committee Administrator

وزارة الصحة
Ministry of Health

KFSH-D Institutional Review Board (IRB)
National Registration Number (H-05-D-002)
Federal Wide Assurance (00018714)
IRB Number (IRB00008686)

IRB Approval Letter
24 October 2012
IRB Reference Number: MOH012-Exp99

Amal Al Aswad
PhD Candidate
The University of Sheffield
amal_0441@hotmail.com

Re: Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals (MOH) in Kingdom Saudi Arabia
Study Number: MOH012

Dear Ms. Amal,

On 7 October 2012, the Institutional Review Board (IRB) of KFSH-D received complete study documents for initial review. On 23 October 2012, the IRB reviewer received and reviewed the study documents. The IRB approves the study documents in versions listed below.

The protocol is approved for one year **24 October 2012 – 24 October 2013**.

- If there are any amendments, please complete the "Amendments Submission Form" and return it to the IRB. Amendments may not be initiated until IRB approval has been obtained
- If you need to extend the IRB Approval, please submit an application for continuation of approval by **23 September 2013**.
- Upon study completion, we would be grateful if you could submit a final report.

If you have any further enquiries regarding the IRB's decision, you may contact the IRB Coordinator at Jamhawilo@kfsh.med.sa

Research Proposal	Version 1/ July 08, 2012
Participants Information Sheet for the survey	Version 1/ July 082012
Consent Form for Interview Participants	Version 1/ July 082012
Interview Questions	Version 1/ July 082012
Survey Questionnaire	Version 1/ July 082012
Research Sites	Ministry of Health Hospitals, Saudi Arabia

We thank you for submitting your study for review by the IRB at KFSH-D and wish you all the best with this study.

Khalid Akkari, MD
IRB Chairman
KFSH-D

Mohamed Sager, MD, PhD
Director, Research Administration
KFSH-D

وزارة الصحة
Ministry of Health

KFSH-D Institutional Review Board (IRB)
National Registration Number (H-05-D-002)
Federal Wide Assurance (00018714)
IRB Number (IRB00008686)

<u>Conditions of Approval</u>

1. IF THE STUDY IS TO BE CONDUCTED OUTSIDE KING FAHAD SPECIALIST HOSPITAL- DAMMAM, PERMISSION OF THE ADMINISTRATION OF THAT INSTITUTION AND OR ITS IRB (IF AVAILABLE) MUST BE SOUGHT AND SECURED BEFORE THE STUDY CAN BE CONDUCTED.
2. Failure to obtain this permission may result in a delay in the start of your research.
3. No subjects may be included in a study procedure prior to the first patient in (FPI) as specified in the protocol. This means that nothing can be done with subjects until after the date of the FPI.
4. All unanticipated or serious adverse events must be reported to the IRB within 5 days.
5. All protocol modifications must be IRB approved prior to implementation unless they are intended to reduce risk. This includes any change of investigator, or site address.
6. Inform the IRB prior to making prospective changes to the study procedures. If you know something will change, the IRB should also know.
7. All protocol deviations must be reported to the IRB within 5 working days.
8. All recruitment materials and methods must be approved by the IRB prior to being used, as these would be considered modifications.
9. If a study activity will continue after the expiration date, the sponsor and investigator(s) are responsible for initiating the Continuing Review proceedings.

Khalid Akkari, MD
IRB Chairman
KFSH-D

Mohamed Saqer, MD, PhD
Director, Research Administration
KFSH-D

وزارة الصحة
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IRB Number (IRB00008686)

IRB Reference Number: MOH012-Exp99

اسم الطالب: أ امال محمد رضي الاسود:

التاريخ: 24 أكتوبر 2012

تفيد لجنة تقييم أخلاقيات الأبحاث في مستشفى الملك فهد التخصصي بالدمام أنه لا مانع من قيام الطالبة المدون اسمها أعلاه بدارسة ميدانية بعنوان:

(وضع السجل الطبي الالكتروني في مستشفيات وزارة الصحة بالمملكة العربية السعودية)

(Issues of Electronic Health Records' Adoption and Usage in Ministry of Health Hospitals in Kingdom of Saudi Arabia)

و ذلك في اطار رسالتها لمرحلة الدكتوراه في جامعة شفيلد.

هذا و قد تم إصدار هذا الخطاب بناء على طلب منها ، و ذلك لتقديمه إلى الملحقية الثقافية السعودية بلندن.

رئيس لجنة تقييم أخلاقيات الأبحاث
د. خالد عكاري
التوقيع
الختم

مدير قسم الابحاث
د. محمد صقر
التوقيع
الختم